NATURE

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"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH

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THURSDAY, NOVEMBER 4, 1880

THE FIRST VOLUME OF THE PUBLICATIONS OF THE "CHALLENGER"

FOUR years have elapsed since the *Challenger* returned from her famous cruise, and the scientific world has been looking, of late perhaps somewhat impatiently, for the first instalment of the long series of volumes which is to embody the results of the investigations of the best-equipped voyagers who ever left the shores of England for the purpose of enlarging the bounds of natural knowledge.

But this is one of the many cases in which impatience is more natural than justifiable In the "General Introduction" with which Sir Wyville Thomson prefaces the "Reports" which are to appear in the first volume of the great work for which he is responsible, he mentions that the zoological specimens collected and preserved in alcohol during the voyage filled 2270 large glass jars, 1749 smaller bottles, 1860 glass tubes, and 176 tin cases; while 22 casks and 180 tin cases held objects preserved in other ways.

In dealing with this vast mass of material, Sir Wyville Thomson justly considered it to be his duty to obtain, as far as it was practicable so to do, the co-operation of the best specialists in every department, irrespective of nationality; and it is gratifying to find that, in reply to his invitations, many foreign men of science of great distinction have willingly associated themselves with a strong corps of English workers. This matter being arranged, the specimens had to be distributed to their destinations; and the several workers, rarely men of much leisure, found themselves embarked in months or years of critical and laborious investigation. Along with this went the slow process of writing out the results, and the still slower of executing the illustrations with due care, all of which had to be finished before the printer could begin his operations.

To those who are familiar with the amount of expenditure of trouble and time which all these processes mean, it will seem no small matter that seven treatises, illustrated by a large number of admirably executed plates, are now ready for distribution, and that three more volumes of no less magnitude are to be issued before the end of the year, so that the fifteen or sixteen volumes of which the whole work is to consist may reasonably be expected to be in the hands of the public by 1884

The "Zoological Reports," as these separate treatises upon each group of specimens are termed, are printed as they are completed, and are to be issued, without reference to the order which they will eventually occupy, as soon as sufficient matter to form a volume is ready. Each memoir will be separately paged, and will have its own legend for reference. This arrangement has been adopted in order that working naturalists may have access to the "Reports" as early as practicable, and that the multiplication of synonyms by the simultaneous publication of species by different observers may be avoided With this object in view, it would perhaps have been even better to have issued every "Report" as it was ready, but it may be that there are practical difficulties in the way of the adoption of this course

The present writer, though a fairly swift reader, does not profess to have perused the seven elaborate memoirs now presented on behalf of the *Challenger*, nor if he had does he lay claim to that zoological omniscience which would justify him in criticising them in detail. But as Mr. Brady deals with the Ostracoda, Mr Davidson with the Brachiopoda, Dr Gunther with the Shore Fishes, Prof Kolliker with the Pennatulidæ, Mr Moseley with those groups of Corals which he has made his special study, Mr Parker with the Development of the Chelonian Skull, and Prof. Turner with the Cetacea, it is questionable if any extant finite knowledge is likely to enable its possessor to say anything more or better than they have said on these respective topics And, as has been already remarked, there can be no sort of doubt as to the artistic excellence of the 122 quarto plates which illustrate and adorn the text.

Sir Wyville Thomson's "General Introduction," however, is extremely readable both in size and in substance, and may be commended to that patient omnivore, the General Reader, who will find in its earlier pages a readily intelligible account of the fittings and appliances of the *Challenger*, and of the means by which the greatest depths of the sea have been made to yield some, at any

rate, of the secrets of the busy life which, contrary to all the beliefs of the naturalists of a past generation, blindly toils and moils in the darkness and cold of the marine abysses

The latter half of the "Introduction" will be no less interesting to the biologist, since it embodies the general conclusions at which the scientific director of the Expedition has arrived, in a dissertation on the nature and distribution of the fauna of the deep sea

Sir W Thomson considers that the most "prominent and remarkable biological result" of the four years' work of the *Challenger* is the final establishment of the fact "that the distribution of living beings has no depth-limit, but that animals of all the marine invertebrate classes, and probably fishes also, exist over the whole of the floor of the ocean." As to the exact nature of this deep-sea fauna at the greatest depths, he speaks with some hesitation; but, at about 2000 fathoms, the list given on pages 36 and 37 proves that there is a large and a varied assemblage of forms of life. Upwards, this characteristic deep-sea fauna extends to about 600 fathoms, and is richest between this depth and 1000 or 1200 fathoms Around all coasts, in temperate regions, the local shore forms, which occupy successive zones of depth as, on land, they characterise zones of height, gradually die out towards the 200-fathom line Nor is there any close relation between the abyssal and the shore faunæ of any given latitude or longitude—on the contrary, the abyssal fauna is singularly uniform and appears "to have been derived from a genetic source different from that of the shore fauna." In fact, Sir Wyville Thomson appositely compares the abyssal ocean—that is the sea everywhere below 200 fathoms or thereabouts—to a world-wide lake of comparatively still water, which, in its deeper parts, is very cold, its temperature neither rising nor falling appreciably beyond the average of 35° F.

Thus there is a certain parallel between land and sea distribution, inasmuch as all Alpine floræ present marked analogies with circumpolar floræ The cold land is discontinuous, whence it presents, as it were, islands of analogous population all over the world; while the cold water being continuous, the continuity in its population is correspondingly unbroken. But the uniformity and invariability of conditions is far more complete in the abyssal lake than on the mountain-tops, and the homogeneity of the population harmonises with that of the medium in which it lives.

Sir Wyville Thomson draws attention to the fact that this widespread abyssal fauna

". . . . has a relation to the deep-water fauna of the Oolite, the Chalk, and the Tertiary formations, so close that it is difficult to suppose it in the main other than the same fauna which has been subjected to a slow and continuous change under slightly varying circumstances according to some law, of the nature of which we have not as yet the remotest knowledge" (p. 49).

"There is every reason to believe that the existing physical conditions of this area date from a very remote period, and that the present fauna of the deep sea may be regarded as directly descended from faunæ which have necessarily occupied the same deep sea . . . That the present abyssal fauna is the result of progressive change there can be no room for doubt; but it would seem that in this case, the progress has been extremely slow, and that it has been brought about almost in the absence of those causes—such as minor and local oscillations of the crust of the earth producing barriers and affecting climate—on which we are most inclined to depend for the modification of faunæ. The discovery of the abyssal fauna, accordingly, seems to have given us an opportunity of studying a fauna of extreme antiquity, which has arrived at its present condition by a slow process of evolution from which all causes of rapid change have been eliminated" (p. 50).

That the deep-sea fauna presents us with many forms which are the dried and but little modified descendants of Tertiary and Mesozoic species is a proposition which few who attend to the evidence will be disposed to deny. But I may venture to express some doubt, whether it may not be well to keep a conclusion of such gravity and so well founded, apart from views respecting the absence of "minor local oscillations of the crust of the earth" in the area of the present great ocean basins, which Sir Wyville Thomson expresses more fully elsewhere.

"There seems to be sufficient evidence that all changes of level since the close of the Palæozoic period are in direct relation to the present coast lines.

"There does not seem to be a shadow of reason for supposing that the gently undulating plains, extending for over a hundred million of square miles, at a depth of 2500 fathoms beneath the surface of the sea, and presenting, like the land, their local areas of secular elevation and depression, and their centres of more active volcanic disturbance were *ever* raised, at all events in mass, above the level of the sea, such an arrangement, indeed, is inconceivable" (p. 46).

I must plead ignorance of the "sufficient evidence" to which Sir Wyville Thomson refers; in fact, I should have thought that the sufficient evidence lay in the other direction Surely there is evidence enough and to spare that the Cretaceous sea, inhabited by various forms, some of whose descendants Sir W. Thomson, as I believe justly, recognises in the present deep-sea fauna, once extended from Britain over the greater part of Central and Southern Europe, North Africa, and Western Asia to the Himalayas. In what possible sense can the change of level which has made dry land and sometimes mountain masses of nine-tenths of this vast area be said to be "in direct relation to the present existing coast lines"?

That the abyssal plains were ever all elevated, at once, is certainly so improbable that it may justly be termed inconceivable, but there is nothing, so far as I am aware, in the biological or geological evidence at present accessible, to render untenable the hypothesis that an area of the mid-Atlantic or of the Pacific sea-bed as big as Europe should have been upheaved as high as Mont Blanc and have subsided again any time since the Palæozoic epoch, if there were any grounds for entertaining it.

In concluding the "Introduction" Sir Wyville Thomson expresses "a strong personal impression" on two points. The one is that the study of the abyssal fauna lends a powerful support to the doctrine of evolution. The other is, that "the character of the abyssal fauna refuses to give the least support to the theory which refers the evolution of species to extreme variation guided only by natural selection" But the grounds assigned for the latter opinion are hardly so cogent as might be desirable.

"Species are just as distinctly marked in the abyssal

fauna as elsewhere, each species varying within its definite range as each species appears to have varied at all times past and present" (p. 50).

Exactly so; the abyssal species are like species elsewhere. The difficulties in the way of the application of the evolution of species by variation and selection therefore in this case cannot be greater than elewhere. In fact, from the sentences which end the "Introduction" it seems doubtful whether they are not less than in many other cases.

"Transition forms linking species so closely as to cause a doubt as to their limit are rarely met with. There is usually no difficulty in telling what a thing is" (p. 50).

Hence it appears that the study of the abyssal fauna has satisfied Sir Wyville Thomson that transitional forms are sometimes met with, and that, sometimes, he has found a difficulty in "telling what a thing is." And this admission is all that the most ardent disciple of Mr Darwin could desire.

However, the value of the great work which is now being brought before the public does not lie in the speculations which may be based upon it, but in the mass and the solidity of the permanent additions which it makes to our knowledge of natural fact. Sir Wyville Thomson and his colleagues must be congratulated on having made an excellent beginning, the looker-on may properly content himself with wishing them a speedy and a good ending.

T. H. HUXLEY

THE LAVA-FIELDS OF NORTH-WESTERN EUROPE

FROM the earliest times of human tradition the basin of the Mediterranean has been the region from which our ideas of volcanoes and volcanic action have been derived. When the old classical mythology passed away and men began to form a more intelligent conception of a nether region of fire, it was from the burning mountains of that basin that the facts were derived which infant philosophy sought to explain. Pindar sang of the crimson floods of fire that rolled down from the summit of Etna to the sea as the buried Typhoeus struggled under his mountain load. Strabo, with matter-of-fact precision and praiseworthy accuracy, described the eruptions of Sicily and the Aeolian Islands, and pointed out that Vesuvius, though it had never been known as an active volcano, yet bore unequivocal marks of having once been corroded by fires that had eventually died out from want of fuel. In later centuries, as the circle of human knowledge and experience has widened, it has still been by the Mediterranean type that the volcanic phenomena of other countries have been judged. When a geologist thinks or writes of volcanoes and volcanic action, it is the structure and products of such mountains as Etna and Vesuvius that are present to his mind. Nowhere over the whole surface of the globe have eruptions been witnessed different in kind though varying in degree from those of the Mediterranean vents. And hence even among those who have specially devoted themselves to the study of volcanoes there has been a tacit assumption that from the earliest times and in all countries of the world where volcanic outbreaks have occurred, it has been from local vents like those of Etna, the Aeolian Islands, the Phlegraean Fields, or the Greek Archipelago.

If one were to assert that this assumption is probably erroneous, that the type of volcanic "cones and craters" has not been in every geological age and all over the earth's surface the prevalent one, that, on the contrary, it is the less portentous, though possibly always the most frequent type of volcanic action, and belongs perhaps to a feebler or waning degree of volcanic excitement—these statements would be received by most European geologists with incredulity, if not with some more pronounced form of dissent. Yet I am convinced that they are well founded, and that a striking illustration of their truth is supplied by the greatest of all the episodes in the volcanic history of Europe—that of the basalt-plateaux of the north-west.

It is now some twelve years since Richthofen pointed out that on the Pacific slope of North America there is evidence of the emission of vast floods of lava without the formation of cones and craters. Geologists interested in these matters may remember with what destructive energy Scrope reviewed his "Natural System of Volcanic Rocks", how he likened it to the old crude ideas that had been in vogue in his younger days, and which a study of the classical district of Auvergne had done so much to dispel; and how he ridiculed what he regarded as "fanciful ideas" and "untenable distinctions," which it was "a miserable thing" to find still taught in mining-schools abroad. My own reverence for the teaching of so eminent a master and so warm-hearted a friend led me to acquiesce without question in the dictum of the author of "Considerations on Volcanoes." Having rambled over Auvergne with his admirable sections and descriptions in my hand, I knew his contention as to the removal of cones and craters by denudation and the survival of more or less fragmentary plateaux once connected with true cones to be undoubtedly correct with respect at least to that region. Nevertheless there were features of former volcanic action on which the phenomena of modern volcanoes seemed to me to throw very little light. In particular the vast number of fissures which in Britain had been filled with basalt and now formed the well-known and abundant "dykes" appeared hardly to connect themselves with any known phase of volcanism. The area over which these dykes can be traced is probably not less than 100,000 square miles, for they occur from Yorkshire to Orkney, and from Donegal to the mouth of the Tay. As they pierce formations of every age, including the Chalk, as they traverse even the largest faults and cross from one group of rocks into another without interruption or deflection, as they become more numerous towards the great basaltic plateaux of Antrim and the Inner Hebrides, and as they penetrate the older portions of these plateaux, I inferred that the dykes probably belonged to the great volcanic period which witnessed the outburst of these western basalts. Further research has fully confirmed this inference. There can be no doubt that the outpouring of these great floods of lava of which the hills of Antrim, Mull, Morven, Skye, Faroe, and part of Iceland are merely surviving fragments and the extravasation of these thousands of dykes are connected manifestations of volcanic energy during the Miocene period.

But this association of thin nearly level sheets of basalt piled over each other to a depth of sometimes 3,000 feet, with lava-filled fissures sometimes 200 miles distant from

them, presented difficulties which in the light of modern volcanic action remained insoluble. The wonderfully persistent course and horizontality of the basalts with the absence or paucity of interstratified tuffs, and the want of any satisfactory evidence of the thickening and uprise of the basalts towards what might be supposed to be the vents of eruption were problems which again and again I attempted vainly to solve. Nor so long as the incubus of "cones and craters" lies upon one's mind does the question admit of an answer. A recent journey in Western America has at last lifted the mist from my geological vision Having travelled for many leagues over some of the lava-fields of the Pacific slope, I have been enabled to realise the conditions of volcanism described by Richthofen and, without acquiescing in all his theoretical conclusions, to judge of the reality of the distinction which he rightly drew between "massive eruptions" and ordinary volcanoes with cones and craters. Never shall I forget an afternoon in the autumn of last year upon the great Snake River lava desert of Idaho. It was the last day of a journey of several hundred miles through the volcanic region of the Yellowstone and Madison We had been riding for two days over fields of basalt, level as lake bottoms, among the valleys, and on the morning of the last day, after an interview with an armed party of Indians (it was only a few days before the disastrous expedition of Major Thornburgh, and the surrounding tribes were said to be already in a ferment), we emerged from the mountains upon the great sea of black lava which seems to stretch illimitably westwards. With minds keenly excited by the incidents of the journey, we rode for hours by the side of that apparently boundless plain Here and there a trachytic spur projected from the hills, succeeded now and then by a valley up which the black flood of lava would stretch away into the high grounds It was as if the great plain had been filled with molten rock which had kept its level and wound in and out along the bays and promontories of the mountain-slopes as a sheet of water would have done. Copious springs and streams which issue from the mountains are soon lost under the arid basalt The Snake River itself, however, has cut out a deep gorge through the basalt down into the trachytic lavas underneath, but winds through the desert without watering it. The precipitous walls of the cañon show that the plain is covered by a succession of parallel sheets of basalt to a depth of several hundred feet. Here and there, I was told, streams that have crossed from the hills and have flowed underneath the lava-desert issue at the base of the cañon-walls, and swell the Snake River on its way to the Pacific The resemblance of the horizontal basalt-sheets of this region to those with which I was familiar at home brought again vividly before my mind the old problem of our Miocene dykes and Richthofen's rejected type of "massive" or fissure eruptions I looked round in vain for any central cone from which this great sea of basalt could have flowed. It assuredly had not come from the adjacent mountains, which consisted of older and very different lavas round the worn flanks of which the basalt had eddied. A few solitary cinder cones rose at wide intervals from the basalt plain, as piles of scoriæ sometimes do from the vapour vents on the surface of a Vesuvian lava-stream, and were as unequivocally of secondary origin. Riding hour after hour among these arid wastes, I became convinced that all volcanic phenomena are not to be explained by the ordinary conception of volcanoes, but that there is another and grander type of volcanic action, where, instead of issuing from separate vents and piling up cones of lava and ashes around them, the molten rock has risen in fissures, sometimes accompanied by the discharge of little or no fragmentary material, and has welled forth so as to flood the lower ground with successive horizontal sheets of basalt. Recent renewed examination of the basalt-plateaux and associated dykes in the west of Scotland has assured me that this view of their origin and connection, which first suggested itself to my mind on the lava-plains of Idaho, furnishes the true key to their history

The date of these lava-floods of the Snake River is in a geological sense quite recent. They have been poured over the bottoms of the present valleys, sealing up beneath their sheets of solid stone river-beds and lake-floors with their layers of gravel and silt. The surface of the lava is in many places black and bare as if it had cooled only a short while ago Yet there has been time for the excavation of the Snake River cañon to a depth of 700 feet through the basalt-floor of the plain. In so arid a climate, however, the denudation of this floor must be extremely slow Much of the plain is a verdureless waste of loose sand and dust which has gathered into shifting dunes. Save in the gorges laid open by the main river and some of its tributaries hardly any sections have yet been cut into the volcanic floor Dykes and other protrusions of basalt occur on the surrounding hills, but the chief fissures or vents of emission are still no doubt buried beneath the lava that escaped from them.

In North-Western Europe, however, the basalt-sheets were erupted as far back as Miocene times. Since then, exposed to many vicissitudes of geological history—subterranean movement and changes of climate, with the whole epigene army of destructive agencies, air, rain, frost, streams, glaciers, and ice-sheets—the volcanic plateaux, trenched by valleys two or three thousand feet deep and a mile or more in breadth, and stripped bodily off many a square mile of ground over which they once spread, have been so scarped and cleft that their very roots have been laid bare. Viewed in the light of the much younger basalts of the Western Territories of North America, their history becomes at last intelligible and more than ever interesting. We are no longer under the supposed necessity of finding volcanic cones vast enough to have poured forth such wide-spread floods of basalt. The sources of the molten rock are to be sought in those innumerable dykes which run across Britain from sea to sea, and which in this view of their relations at once fall into their place in the volcanic history of the time.

No more stupendous series of volcanic phenomena has yet been discovered in any part of the globe. We are first presented with the fact that the crust of the earth over an area which in the British Islands alone amounted to probably not less than 100,000 square miles, but which was only part of the far more extensive region that included the Faroe Islands and Iceland, was rent by innumerable fissures in a prevalent east and west or south-east and north-west direction. These fissures, whether due

to sudden shocks or slow disruption, were produced with such irresistible force as to preserve their linear character and parallelism through rocks of the most diverse nature, and even across old dislocations having a throw of many thousand feet. Yet so steadily and equably did the fissuring proceed over this enormous area, that comparatively seldom was there any vertical displacement of the sides. We rarely meet with a fissure which has been made a true fault with an upthrow and downthrow side.

The next feature is the rise of molten basalt up these thousands of fissures. The most voluminous streams of lava that have issued from any modern volcanic cone appear but as a minor manifestation of volcanic activity when compared with the filling of those countless rents over so wide a region. Mining operations in the Scottish coal-fields have shown that dykes do not always reach the surface. In all parts of the country, too, examples may be observed of breaks in the continuity of dykes. The same dyke vanishes for an interval and reappears on the same line, but is doubtless continuous underneath. What proportion of the dykes ever communicated with the surface at the time of their extravasation is a question that may perhaps never be answered. It is difficult to believe that a considerable number of them did not overflow above ground even far to the east of the main and existing outflows But so extensive has been the subsequent denudation that all trace of such superficial emission has been removed The general surface of the country has been lowered by sub-aerial waste several hundred feet at least, and the dykes now protrude as hard ribs of rock across the hills.

Traced westwards the dykes increase in abundance, till at last they reach the great basaltic plateaux Macculloch long ago sketched them in Skye, rising through the Jurassic rocks and merging into the overlying sheets of basalt. Similar sections occur in the other islands and in the north of Ireland The lofty mural escarpments presented by the basalt plateaux once extended far beyond the limits to which they have now been reduced. The platform from which they have been removed shows in its abundant dykes the fissures up which the successive discharges of lava rose to the surface, where they overflowed in wide level sheets like those still so fresh and little eroded in Western North America

That there were intervals between successive outpourings of basalt is indicated by the occasional interstratification of seams of coal and shale between the different flows. These partings contain a fragmentary record of the vegetation which grew on the neighbouring hills and which may even have sometimes found a foothold on the crumbling surface of the basalt floor until overwhelmed by fresh floods of lava. Not a trace of marine organisms has anywhere been found among these interstratifications There is every reason to believe that the volcanic eruptions were all subaërial. Sheet after sheet was poured forth over the wide valley between the mountains of Donegal and the Outer Hebrides on the one side and those of the north-east of Ireland and the west of Scotland on the other, until the original surface had been buried in some places 3000 feet beneath volcanic ejections.

I believe that the most stupendous outpourings of lava in geological history have been effected not by the familiar type of conical volcano, but by these less known fissure-eruptions Both types are of course only manifestations in different degrees of the same volcanic energy. It is by no means certain that the "massive" or fissure type belongs wholly to former geological periods. In particular one is disposed to inquire whether the great Icelandic lava-floods of 1783—the most voluminous on record—may not have been connected rather with the opening of wide-reaching fissures than with the emissions of a single volcanic cone The reality and importance of the grander phase of volcanism marked by fissure-eruptions have been recognised by some of the able geologists who in recent years have explored the Western States and Territories of the American Union But they have not yet received due acknowledgment on this side of the Atlantic, where the lesser type of cones and craters has been regarded as that by which all volcanic manifestations must be judged. We are fortunate in possessing in the north-west of Europe so magnificent an example of fissure-eruptions, and one which has been so dissected by denudation that its whole structure can be interpreted. The grand examples on the Pacific slope of America have yet to be worked out in detail, and will no doubt cast much fresh light on the subject, more especially upon those phenomena of which in Europe the traces have been removed by denudation But the other continents also are not without their illustrations. The basaltic plateaux of Abyssinia and the "Deccan traps" of India probably mark the sites of some of the great fissure-eruptions which have produced the lava-fields of the Old World. In their recent admirable *résumé* of the "Geology of India," Messrs Medlicott and Blanford describe the persistent horizontality of the vast basalt-sheets of the Deccan, the absence of any associated volcanic cones or the least trace of them in that region, and the abundance of dykes in the underlying platform of older rocks where it emerges from beneath the volcanic plateaux. They confess the difficulty of explaining the origin of such enormous outpourings of basalt by reference to any modern volcanic phenomena Their descriptions of these Indian Cretaceous lava-floods might, however, be almost literally applied to the Miocene plateaux of North-western Europe and to the Pliocene or recent examples of Western North America. ARCH GEIKIE

THE ATOMIC THEORY

The Atomic Theory. By Ad. Wurtz, Membre de l'Institut, &c. Translated by E. Cleminshaw, M.A (London C. Kegan Paul and Co., 1880.)

THE latest addition to the International Scientific Series is at once a scientific treatise and an artistic work. The translator has very fairly maintained the clearness and crispness of the French style, whereby the book is marked with a distinct individuality and self-completeness.

The sharpness of the impression which this work produces on the mind is gained without making any great sacrifice of accuracy, although it must be confessed there is, in some chapters, a lack of detailed facts, which is against the value of the work as a reference book for the advanced student; and in others there is too free a use of fancy, which faculty is not synonymous with that

other without which no great scientific work can be produced, viz., imagination.

The work is divided into two books. the first, and most valuable, treating of "Atoms," the second of "Atomicity." The historical introduction is very full, and remarkable for the clear exposition of the work of Richter, which was of so much importance in the subsequent development of the doctrine of atoms. The error, which is still fallen into in some books, of attributing the "law of proportionality" to Wenzel is pointed out and corrected.

Full justice is not done to the work of Avogadro, on which, confirmed as it has been by physical evidence, rests the structure of modern chemistry. The distinction between "integral molecules" and "elementary molecules" was clearly stated by Avogadro in 1811, three years before the date of the publication of Ampère's letter to the Comte Berthollet. Ampère's attempt to extend the hypothesis to facts concerning crystalline bodies cannot be regarded as an improvement on the simpler conception of Avogadro.

But throughout this work there is a manifest resolve to abate no jot nor tittle of that assertion, which, made with the plenary knowledge of a chemical Philistine, sounded the keynote of M. Wurtz's well-known "History of the Atomic Theory."

The statement on p 42 of the reasons for adopting H_2 as the standard of molecular weights is neither clear nor satisfactory The student might readily suppose that this standard is adopted simply for the sake of convenience; he might also be led to regard the statement of Avogadro's law, on this page, as a deduction from some vaguely-expressed relations between the number of atoms in elementary molecules and the volumes occupied by these atoms

Few text-books make clear the fundamental deficiency of the Daltonian theory, viz, the absence of any trustworthy means for determining the weights of the "atoms" (or as we now say, molecules) of compound bodies Dalton, and Berzelius after him, laid down rules for determining these weights, but the rules of both chemists were wholly empirical. "The atomic weight of an element is the smallest amount of that element which combines with unit-weight of hydrogen to form an atom of a compound," but so long as the "atom" of the compound was undefined, the atomic weight of the element could not be determined.

Avogadro furnished chemists with a means of determining the molecular weights of all gasifiable bodies, and in modern chemistry determinations of molecular weights of many compounds of a given element, and analyses of these compounds, must precede the determination of the atomic weight of the element itself

The atomic weight of an element is the smallest amount of that element—referred to hydrogen as unity—contained in the molecule, that is in two gaseous volumes of any compound thereof For lack of a clear differentiation between atom and molecule, and for lack of a definite statement of how atomic weights are determined, the full and valuable table, extending from p. 104 to 109, loses much of its meaning This table, by the way, very closely resembles a table which occurs in Lothar Meyer's "Die modernen Theorieen"; the alterations made by M. Wurtz certainly do not add to the value of the table.

Dalton's objections to the generalisation of Gay Lussac, that "equal volumes of gases contain equal numbers of atoms," was, as we now know, perfectly justifiable, but on p. 35 Dalton is said to have repudiated "the solid support which the great French chemist gave to his ideas."

Gay Lussac's generalisations could not be true, said Dalton, because of such a reaction as that between nitrogen and oxygen, wherein equal volumes of each combine, and the product, nitric oxide, measures twice the volume of either; that is, there are, according to Gay Lussac, twice as many atoms of nitric oxide as of oxygen or nitrogen, but as elementary atoms are chemically indivisible, this is impossible. Berzelius obviated, or rather shirked, the difficulty by applying Gay Lussac's generalisations to elementary gases only, but a full reconciliation between the views of Dalton and those of Gay Lussac was only possible when Avogadro's fruitful idea of the existence of molecules as distinct from atoms was fully recognised in chemical science.

In describing the physical methods for checking atomic weight determinations, the law of Dulong and Petit is stated in too absolute a manner, if the data concerning the specific heats of the elements are carefully considered, it is evident that in many cases the value varies very much with temperature, that in others no direct determination of specific heat has yet been made, and that the law cannot be regarded as a final statement of the connection between the specific heats and atomic weights of the elements

The state of our knowledge with regard to the structure of molecules, indeed, renders a full understanding of specific heat at present impossible. The dynamical theory of gases has not yet been fully worked out in this direction.

Although the "law of Avogadro" is a deduction from the dynamical theory of gases, and as such is invested with an authority which no mere collection of empirical facts can bestow upon it, yet nowhere in M. Wurtz's book is this insisted upon.

The compromise between an atomic and an equivalent system of notation, which was so long adopted by chemists, is well described and its evils fully laid bare.

The objectors to Avogadro's law are more numerous and more important in France than in this country or in Germany, hence M. Wurtz devotes considerable space to the subject of dissociation, which he discusses with much clearness and wealth of illustration.

The demonstration on pp. 121-123 of the monatomic character of the mercury molecule is admirable.

In the list of names of those who have pointed out relations between the atomic weights of elements and properties of their compounds, there is a serious omission, viz, the name of A. R. Newlands. This subject of relation between atomic weights and properties of compounds is discussed on pp. 154-176. A better idea of Mendelejeff's "periodic law" may be obtained from these pages than probably from any other English text-book, but surely it would have been well had the author more explicitly acknowledged his indebtedness to Lothar Meyer's work. The graphic representation of the relations between the atomic weights and physical properties of the elements—taken from Meyer's book—has not hitherto been in the hands of the English student.

The second part of M. Wurtz's book, dealing with Valency, is not, in our opinion, of equal value with the first.

After reading these chapters one finds it hard to find a reason for introducing into science the conception of valency, so variable and shifting is this property of atoms made to appear.

On p. 229 it is stated that chlorine is monovalent in $HClO$, pentavalent in $HClO_3$, and heptavalent in $HClO_4$.

Scarcely a hint is given of the many objections to extending considerations concerning valency, in any but a most tentative manner, to non-gasifiable bodies. The theory of molecular as distinct from atomic compounds is dismissed; all are regarded as atomic, and the valencies of the atoms seem variable at pleasure. Where proof of the valency of atoms is not forthcoming, assertion is used in its place

The author's treatment of affinity is not satisfactory "Affinity is the force of combination, chemical energy." "Atoms attract each other, and this atomic attraction is affinity." "Thus we know that while hydrogen is united to chlorine with extreme energy, oxygen combines with less force" Surely the translator is to blame for some of these sentences.

The theory of valency deserved a more rigorous and exact treatment than M. Wurtz has given it.

We leave the book, feeling that it is the production of a brilliant author, not the work of a deep thinker

M. M P M.

NEW ZEALAND MOLLUSCS

Manual of the New Zealand Mollusca By Frederick Wollaston Hutton, F.G.S. Published by command. (Wellington, 1880)

IN an interesting article which appeared in NATURE, vol. xxii. p. 461, entitled "The New Zealand Institute," attention was called to the publications of the Institute and to the excellent work in science achieved by the author of the manual above mentioned, and by many other naturalists, as well by geologists, chemists, astronomers, archæologists, physicists, and philosophers. When the traditional New Zealander visits the ruins of the old country, it is to be feared that he will lament our ignorance instead of expressing his admiration of our past eminence.

Prof. Hutton seems to have contributed to the publications of the Institute a number of valuable papers on "the various divisions of the fauna of New Zealand" We are not quite sure that our knowledge of any one department of the fauna would be so much advanced by a multifarious zoologist as by a specialist who has devoted himself to the study of that department. The division of labour is not less desirable in natural history than in other equally extensive fields of work. The material is so vast that a Linné, Buffon, or Cuvier would be now rather an anachronism than a marvel.

The present work is called "A Systematic and Descriptive Catalogue of the Marine and Land Shells, and of the soft Mollusks and Polyzoa of New Zealand and the adjacent Islands." It belongs to the Colonial Museum and Geological Survey Department, of which Dr. Hector, the well-known geologist, is the director. Its scope is most useful; and, as the preface by Dr. Hector very properly states, "an accurate knowledge of the affinities and distribution of the recent shells of New Zealand is a very necessary element in the geological survey of the country, as it must form the basis of our Tertiary geology, upon the correct deciphering of which many questions of the highest interest depend" And he adds, "Shells afford the most reliable data for palæontologists, but before the extinct shell-fauna can be utilised, the recent shells of the area must be thoroughly determined." This is quite true. We are disposed, however, to carry the process a step further. It is not enough to determine or make out the recent shells, but they must be critically compared with their fossil analogues. For want of such comparison the late Prof Nyst, M Vandenbroeck, and other Belgian palæontologists have unfortunately caused some confusion by a wrong identification of recent or living species with Tertiary species.

The "Manual" contains 237 pages. There are no plates or illustrations. It appears to comprise all that is known of the subject, and to have been conscientiously and on the whole carefully written But, like all other books, it is not faultless In the Bibliography "Linneus" is the name given as the author of the 12th edition of the "Systema Naturæ" It ought to be "Linné," according to the title-page and dedication "Gastropoda" is now the usual, as well as correct, spelling of the class, not "Gasteropoda" The shell of the family *Patellidæ* is not a simple cone, but is spiral in the young The *Bullidæ* are not all eyeless The sub-order "Lucinacea" is described as having the gills, "one on each side", but in one of the families of this sub-order there are "two gills on each side" The family "*Radulidæ*" is stated to have the foot "not byssiferous"; *Limahians* with its foot spins a byssus and makes its curious nest. In the "Artificial Key to the Marine Shells" the remarkable class *Solenoconchia* (or as Prof. Hutton in another place prefers to call it, "Scaphopoda") is omitted The shell in "*Capulidæ*" is described as "not spiral" These and other less important errors can be corrected in a future edition. We regret, but are not surprised, to see the remark that "not much dependence can be placed on the localities in Mr. Cuming's collection," which was purchased for the British Museum at a large price. This is the case with all dealers, and it sadly disturbs our ideas of geographical distribution We are inclined to question even such species as *Ostrea edulis*, *Mytilus edulis* and *Lucina* (*Loripes*) *divaricata* as indigenous to New Zealand. These are included in a list of sixty-four species believed by the author to be the only New Zealand species of which there is evidence that they are found anywhere else, although he admits that the identification has in most cases been made solely by descriptions and figures. The same remark applies to *Cypræa europæa*, "*Philippia lutea*" = *Solarium hybridum*, *Littorina cærulescens* = *neritoïdes*, and *Crepidula unguiformis*. But, *per contra*, the *Saxicava australis* of Lamarck is scarcely a variety of *S rugosa*, Linné. The diagnosis of the soft parts, or "animal," of *Vitrina* and *Succinea*, viz, "too large to enter the shell," does not suit the European species of those genera. In the family *Assimineidæ* the eyes are placed not "on the middle of the tentacles," but on their tips. "*Odostomia lactea*" is not the Linnean species of

Turbo, but another species so named by Mr. Angas Nor is the *Nucula sulcata* of A. Adams the same as Bronn's much older species of that name. But a serious defect of the work consists in the description of the shells. We give one instance among many. *Littorina novæ zealandiæ* is described as "somewhat globosely turbinated," with the whorls "spirally irregularly linearly grooved;" and the characters of the several species are not arranged systematically or in any kind of sequence. Dog-Latin would be almost preferable to such English. Perhaps, however, the description of species made by the late Mr Reeve may have been copied from his "Conchologia Iconica" Prof. Hutton says that there are "between 300 and 400 species" of the New Zealand mollusca and polyzoa This is considerably less than half the number of those species which have been recorded as inhabiting the British seas. J. GWYN JEFFREYS

OUR BOOK SHELF

The Zoological Record for 1878, being vol xv of the Record of Zoological Literature, edited by E. C. Rye. (London · John Van Voorst, 1880)

THIS publication seems to pursue the even tenor of its very useful way. The editor has to acknowledge grants of 250*l* towards the expenses of the work from the British Association for the Advancement of Science, the Royal Society, and the Zoological Society of London. The "Record of the Arachnida for 1878" has been unavoidably postponed until vol xvi, and Mr. Kirby has for the future undertaken all of the groups of the Insecta with the exception of the Coleoptera, which the editor will still review. Entomologists will perceive with regret that they thus lose the services of Mr McLachlan, who has reported on the Neuroptera and Orthoptera since 1869 A special committee has been appointed to endeavour to expedite the publication of the annual volume, and arrangements have been made, both as regards the contributors and printers, which it is hoped will have the eventual effect of bringing out the record of one year's work during the succeeding year This would be an immense boon, and though it is obvious that it cannot be effected at the first attempt, still the editor confidently expects that the Record of 1879 will be published in the beginning of 1881, and let us hope that ere the end of that year we may also have the Record of that one now coming to a close.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts No notice is taken of anonymous communications*]

[*The Editor urgently requests correspondents to keep their letters as short as possible The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

The Recent Gas Explosion

ON my return after the vacation the experiments on the explosion of gases in tubes were continued.

A tube was constructed by winding narrow strips of paper helically round a glass tube about 8 mm. in diameter, two-thirds of the width of the paper being glued, it was so wound as to make a tube of three thicknesses of paper. The interior of the tube was afterwards varnished with shellac At the ends short pieces of glass tube about 5 mm. in diameter were fixed, one being provided with platinum wires in order to inflame the gas; the total length of the tube was 4360 mm.

The tube was filled with a mixture of oxygen and hydrogen, the end of the glass tube with the wires was plugged with wet cotton wool, the other tube being closed with an india rubber cap; a spark was then passed. At a distance of 650 mm. from the open end, at which the ignition took place, the outer covering of the tube was split; at a distance of 1,900 mm. from the same point was a hole, at 3030–3040 another hole, and at 3085–3100 a third hole The india-rubber cap was blown off the end of the tube. At the third hole the interior coating of the tube was torn and blown back towards the opening, showing that the orifice had allowed the escape of gas from both directions. Measuring the distances between the holes and the ends of the tube, we have the following numbers:—From end to first split, 650 mm.; from split to first hole, 1250; from first hole to mean of second and third, 1200; from this point to end of tube, 1260

There seemed to be some doubt as to the uniformity of this tube, so another was made by rolling a strip of paper helically along a glass tube in such a manner that the edges did not overlap. A glued strip was wound over this so as to cover the joint; and a third to cover the joint of the second, the edges not overlapping and yet touching one another throughout. The process was very tedious, and as the result showed, not successful. This tube was 7 5 mm. in diameter, and the glass ends 4·5, the total length being 8390 mm. The end of the tube farthest from the wires was firmly closed, after introducing the explosive mixture When the gas was exploded in the tube 14 holes were made, in some places the tube giving way at joints, but without any great tear of the paper Starting from the end of the tube the first hole was at 620 mm., the other holes being distant from one another 650, 530, 100, 475, 375, 320, 580, 455, 370, 885, 2115, 365, 85, and the other end 465 from the last hole

A third tube was now constructed, but on a different principle A sheet of glued paper was wound round a brass tube and at once removed, in this way a tube about 275 mm long and 13 5 wide, and consisting of about 5 layers of paper was obtained. Thirty-two of these were joined end to end by glueing narrow strips of paper round the joints The tube was varnished inside and out, and when completed was 9000 mm. long. The experiment was made after dark, and it was not found out until afterwards that a small quantity of water had entered the tube from the gas holder while introducing the gas In this case the explosion made 10 holes, but the joints obviously considerably strengthened the tube in their neighbourhood The distances between the holes were not more regular than in the previous case. From the end to first hole 757 mm; the other holes being distant 660, 1595, 146, 484, 230, 295, 308, 1325, 585, to end 2615 The end was not opened by the explosion.

Although these experiments have not exhibited the regularity I anticipated, they show that a tube burst by an explosive mixture must not be expected to open along its whole length.

Cooper's Hill, October 25 HERBERT MCLEOD

Geological Climates

I WAS not surprised at reading Mr. Duncan's letter in supposed reply to my communication to NATURE, vol. xxii p 532, as it fully proves my case against the slipshod logic of geologists in general He writes:—"Where I now write, on the Bagshot sands and gravels of Cooper's Hill, facing the cold north with a touch of the east, there is a patch of bamboo canes in full leaf. They were in full leaf at this time last year The plant survived out of doors the extreme frost and fogs of last winter and other evidences of a temperate climate, and it has been in beautiful leaf all this summer.

"Now everybody knows that in torrid India the bamboo grows. . . ."

Mr Duncan might as well have told your readers that where he now writes, "facing the warm south with a touch of the west," he beheld before his astonished eyes a tuft of grasses.

He has not named the *species* of the "patch of bamboo canes" which delighted his eyes, and which "everybody" knows came from "torrid India"

If Mr. Duncan does not know, at least "everybody" does, that species of the bamboo canes flourish in every latitude from Northern China to Southern Chili, including "torrid India," where in some places you may have a half-inch thick of ice, in consequence of the starlight radiation of a clear summer's night.

I have before me a list of twenty-four species of bamboo canes cultivated in most of the gardens of Europe, but they are all, with the exception of a species from the Himalayas (not "torrid India"), imported from the severe climates of Northern Japan and China.

At Fota, in the Cove of Cork, at Bamboo Island, they have lived, fruited, and reproduced themselves for nearly thirty years, and will probably continue to do so in the future, although no Corcagian will be silly enough to believe in consequence thereof that he is living in the climate of "torrid India."

In fact, I adduced the evidence of *Araucaria Cunninghami*, *a most delicate self-registering plant thermometer*, in testimony of the Eocene climate of Bournemouth; and I find myself confronted with Mr. Duncan's clumsy thermometer with *not a single fixed point on its scale*, in the shape of an unspecified "*clump of bamboo canes*." Let Mr. Duncan name the species included in his "clump," and I shall discuss the question fully with him.

The facts stated in my letter, although by no means uncommon, prove most convincingly to those who can appreciate them the untenable nature of Lyell's theory of the cause of change of geological climates.

I must state my argument again :—

1. In Eocene times groves of Moreton Bay pine lived, flourished, and held their ground at Bournemouth against all comers

2. At the present time groves or forests of Moreton Bay pine live, flourish, and hold their ground at Moreton Bay against all comers.

3. Therefore the climate of Bournemouth in Eocene times was similar to that of Moreton Bay at the present time.

Geologists often make use of syllogisms much less conclusive than the above, which is as good as any commonly used in biological reasoning, such as it is.

The present mean temperature of Bournemouth is 20° F. below what it was in Eocene times, which is equivalent to a difference of latitude in the northern hemisphere between 31° N. and 51° N.

Sir Charles Lyell[1] feebly attempts to get rid of scientific conclusions as to temperature in two ways :—

1. By a denial of the specific identity of the former and recent species compared.

2. By the unproved hypothesis of competing plants whose superior vigour and not climatal conditions, account for the absence of the species which formerly flourished

In the case of the Moreton Bay pine I shall leave Mr. Gardner to defend the asserted identity of species, and I meet Sir Charles Lyell's second supposition (which is really romance writing, and not science) by the assertion that the Moreton Bay pine, even if protected by man, will perish in any locality whose *mean winter temperature* falls below 57° F.

The present mean January temperature of Bournemouth is 37°·4 F., a temperature which would destroy in a single night a whole forest of Moreton Bay pines.

I was of course well aware that my argument from the former existence of Moreton Bay pines at Bournemouth was only one of many similar arguments that might be advanced from the former existence of plants or corals in localities in which they do not now live.

I know nothing, except from books, of the water temperature necessary for the several species of corals, nor do I know whether any species of the tertiary corals found in England are *specifically identical* with corals now living elsewhere. If Mr Duncan would give us precise information on this subject he would throw most valuable light on geological climates.

The corals would give us more information upon the question than plants, because they would gauge for us the temperature of the water in England, that is to say, the temperature of the former Gulf streams of the tertiary period, from which we could calculate numerically the increase of solar radiation, necessary to produce such former Gulf streams, and possibly afterwards a measure of geological time.

I have elsewhere[2] shown that the fossil tertiary plant beds of the Arctic regions show a falling off of temperature similar to that which has been proved at Bournemouth, of which the following is a summary :—

	Lat.	Mean annual temperature in Miocene time.	Reduction at present
	°	°	°
Grinnell Land	81 44	42·3 F.	44·00 F.
Spitzbergen	78 00	51·8 ,,	33·30 ,,
Disco	70 00	55·6 ,,	36·00 ,,
		Eocene	
Bournemouth	50·50	70·75 ,,	20·35 ,,

I again assert that it is not possible to explain these facts without introducing causes differing in amount from those now acting on our planet SAML. HAUGHTON

Trinity College, Dublin, October 16

[1] "Principles," vol i p 273 (twelfth edition).
[2] "Lectures of Physical Geography," p 344.

The Yang-tse, the Yellow River, and the Pei-ho

I READ with great interest the paper on the Yang-tse, &c, in NATURE, vol xxii p. 486. It seems to me that Mr Guppy has underestimated the quantity of water and sediment in these rivers As to the Yang-tse, this arises from the year 1877 being one of the driest in Western and Central China generally, and thus the summer flood must have been one of the lowest on record. Besides what we know of the character of the season, an indirect proof of this can be had by comparing the rate of discharge in April and at the time of highest flood, as given by Mr. Guppy, with what is said by Mr. Oxenham, in his paper on the inundations of the Yang-tse.[1] According to the latter the rise of water in April is not very large, the river not yet inundating its banks, and being thirty feet below the summer level. Thus in an average year the discharge in April would by far not equal half of that of August, as found by Mr. Guppy, but more probably be even below one-fifth of that of flood time

On this account the data given by Mr. Guppy for the Yang-tse are far below the average as to the discharge of water, and probably even more so as to the amount of sediment, as the proportion of sediment increases during high floods. In 1877 the loess country of North-West China was subject to the severest drought, so that the Han river, which generally contributes so much to the sediment of the main river, must have been very low in summer.

As to the estimation of the discharge of water in the Pei ho, it is certainly much below the actual quantity, for Mr. Guppy has taken only the months of December to March, *i.e.* months of low water. The monsoon character of the rains, *i.e.* the great prevalence of summer over winter rains, is far more marked in Northern China than in the middle part of that country, so that the flood discharge of the rivers during and after the rains (*i.e.*, from July to October) must be enormously in excess over that of winter. If, as Mr Guppy says, the Pei-ho rises only six feet at Tien-tsin, this must be due to the banks being very low, so that the river during flood-time inundates the plain to a very great extent.

My conclusion is this.—Mr. Guppy having underestimated the discharge of water of the Yang-tse and Pei-ho in the mean of the year, this must have been even more the case as to the amount of sediment carried. Thus the relatively short time at which he estimates that the surrounding seas will be filled by the sediment carried by the great Chinese rivers has to be greatly shortened, and if he thinks 36,000 years enough for the work, I should estimate that 28,000 years would be sufficient.

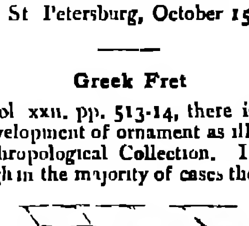
A. WOEIKOF

Schpalernajo 8, St Petersburg, October 15

[1] Journ R. Geog Soc., 1875.

Greek Fret

IN NATURE, vol xxii. pp. 513-14, there is a very interesting account of the development of ornament as illustrated by General Pitt Rivers' Anthropological Collection. I would venture to suggest that though in the majority of cases the Greek fret pattern



1

FIG 1.—Gateway at Labnah (Plate 19).

was independently evolved in different countries from the "double loop-coil," yet a study of the plates in Mr Catherwood's beautiful work, "Views of Ancient Monuments in Central America" (1844), suggests to me the probability that the builders of those remarkable structures arrived at the "Greek pattern" through a degradation of the conventionalised human

face. The accompanying tracings from Catherwood's work will sufficiently explain my meaning.

Fig. 1, from the gateway at Labnah, pl. xix.; Fig. 2, from the gateway of the great Teocallis Uxmal, pl. xii., Fig. 3, from

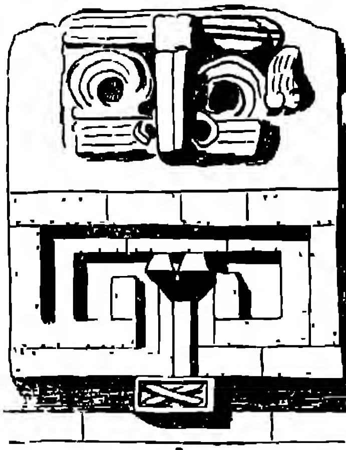


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Fig. 2.—Gateway of the Great Teocallis Uxmal (Plate 12).

Las Monjas Chichen Itza, pl. xxi., illustrate the development of the fret. Fig. 4, from Las Monjas Chichen Itza, pl. xxi, shows another modification of the human face.

In his "Grammar of Ornament" Owen Jones says (p 35) "In Mr. Catherwood's illustrations of the architecture of Yucatan

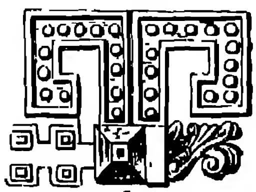

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Fig. 3.—Las Monjas Chichen Itza (Plate 21)

we have several varieties of the Greek fret: one especially is thoroughly Greek. But they are, in general, fragmentary like the Chinese." The reason I would assign for this "fragmentary" nature of the design is that it was just passing from the disjointed *ornament* to the *pattern* stage. An examination of the plates

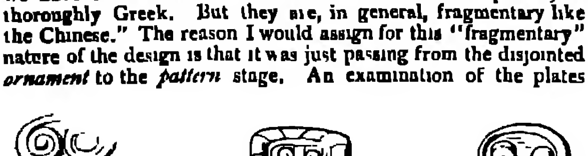


Fig. 4.—Las Monjas Chichen Itza (Plate 21)

will prove the profuse employment of the more or less grotesquely modified human face in mural decoration.

The hypertrophy of one set of organs, with the atrophy of another, and modification of a third, are paralleled in the specialisations of all degraded forms. ALFRED C. HADDON

Zoological Museum, Cambridge

Temperature of the Breath

I AM unable to see what bearing "I. J. M. P.'s" suggestion that I should try the effect of dipping my thermometer, enveloped in a tightly rolled handkerchief, in water at 108° has on this subject. Every one of course knows that a thermometer in such circumstances would eventually acquire the temperature of the water in which it is immersed.

The state of the matter is simply this. On the one hand works on physiology agree in stating that the normal temperature of the breath is from 95° to 97°, and that of the interior of the body from 98°·5 to 99°·5. These are what Mr. McNally would call "ascertained physiological truths." On the other hand I find that by breathing on the bulb of a thermometer enveloped in about twenty folds—more or less—of a silk, cotton, or woollen cloth for five minutes, the thermometer indicates temperatures varying—owing to conditions not yet precisely ascertained—from 102° to 108°, which, as every one knows, are temperatures vastly greater than the accepted temperature of the breath or interior of the body.

There is no question of squeezing up the reading of a delicate thermometer by the tightness of the enveloping material, for the thermometer used in these experiments is an ordinary clinical thermometer, such as I use daily in practice, the bulb of which is made of such stout glass that no amount of pressure short of breaking the bulb will move the mercury in the slightest degree.

The following variation in the mode of experimenting precludes the possibility of any pressure on the thermometer. I put the thermometer in a glass tube about three-fourths of an inch bore, open at both ends, packed the stem loosely with cotton wool, but left the bulb free at one end of the tube. I then enveloped the whole in a silk handkerchief and breathed through twelve folds of the material into the end of the tube where the bulb of the thermometer was, untouched by cotton wool, glass tube, or silk handkerchief. After five minutes the thermometer showed a temperature of 102°. In this case, and I believe also in my former experiments, the enveloping material merely acted as a bad conductor, retaining the heat produced by the breath.

As any one can easily repeat these experiments for himself, I would suggest to your correspondents that they should do so. When the facts have been established by reiterated experiments —my own observations have been corroborated by several of my friends—the explanation or significance of them will no doubt be speedily arrived at. Provisionally I suggest that these observations show respiration to be a powerful agent for getting rid of the superfluous caloric of the body.

How is this heat communicated to the breath? If it had anything to do with the conversion of the carbon of the blood into carbonic acid, the quantity of carbonic acid passed off by the breath would be greater when the temperature of the latter is higher, less when it is lower. But Letellier's experiments show that the amount of carbonic acid exhaled is greatly *increased by external cold*, and *diminished by heat*, whereas my experiments apparently show that the temperature of the breath is *lower in external cold, higher in heat.*

To solve the questions suggested by these experiments one would require the aid of a physiological laboratory, but as that is not at my command, and, moreover, as I could not devote the necessary time to them, I must leave their solution to others.

October 20 R. E. DUDGEON

Soaring of Birds

I BEG to send you some data on the above subject, as I live where the phenomenon is of daily occurrence. Most of the large birds out here soar, *i.e.* can circle round and round without flapping the wings, and also can *rise* thus from 100 or 200 feet to some 8,000 by same means. The pelican, the adjutant, and several large birds allied to it, the vulture and the cyrus, rise thus.

Firstly they rise by flapping the wings vigorously, and when up some 100 or 200 feet, *if there is a breeze*, begin to soar in large circular sweeps, rising 10 to 20 feet at each lap, the whole bird being otherwise quite motionless, and the wings extended rigidly.

We have two steady winds here, from north east and west-south-west, and in one of these the birds rise to great heights, and can be seen as small specks up in the blue, and watched with telescope, going round and round, motionless otherwise. The following data are trustworthy —The birds weigh from 20 to 40 lbs.; spread of wings, 10 to 12 feet, stand 3 to 5 feet high, speed flying or soaring, about 15 to 35 miles per hour (estimated).

They rise by flapping the wings. If there is no wind they $\left\{\begin{array}{l}\text{do not}\\\text{cannot}\end{array}\right\}$ soar; they generally begin to soar at 100 to 200 feet elevation when above the level of the forest. In soaring they $\left\{\begin{array}{l}\text{do not}\\\text{cannot}\end{array}\right\}$ go in a right line, but in large curves of a spiral that leans to *leeward.*

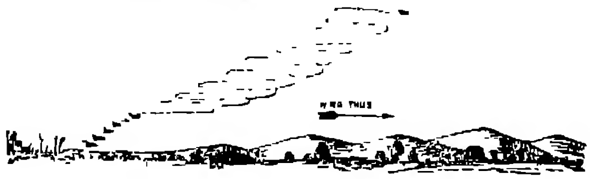
At each lap they can rise 10 to 20 feet, but lose position laterally of 20 to 50 feet to leeward. The soaring can go on without once flapping the wings, till the bird is almost out of sight.

If near, the feather-tips make a loud musical "sing," and the presence often first known by it. If watched, they come

round again nearly to the same place. With gun or rifle against a tree-stem, I have often been able to spot the intersection with my aim beforehand, lap by lap; the drift is to leeward.

I take it the explanation is, that in passing round *with* the wind, and by slightly falling, great impetus is gained, which is slowed down by turning to meet and rise on the wind *like a kite* (if near, this is *seen*). I have seen the albatross and gulls floating, but this case or these cases exemplify a major problem of rising as well steadily and without effort; it is also a clearer problem, the solution of which more or less solves the minor problems of mere flotation.

The line of flight is thus:—



Sapakati, Sibsagor, Asam S. E. PEAL

Regelation

IT is stated in NATURE, vol xxii. p. 589, that Faraday gave the name of *Regelation* to the phenomenon of two pieces of ice freezing together. Surely this is an error? It was in 1856 when Sir Joseph D. (then Dr.) Hooker, Professors Tyndall and Huxley, and the present writer were in Switzerland together. Prof Tyndall asked us to suggest a suitable term for the process, and it was Sir Joseph Hooker who said he could think of none better than *Regelation* Prof Tyndall instantly accepted it as exactly conveying the meaning he required.

Agassiz, however, in writing upon the difficulties of ascertaining the temperatures of glaciers by introducing thermometers into borings, alludes amongst others to "la difficulté d'extraire les fragmens détachés qui se *regelaient* constamment" ("Études sur les Glaciers," p. 203). This shows that a similar expression had occurred to him as suitable for this phenomenon, as early as 1840, in which year his "Études" were published

GEORGE HENSLOW

JOHANNES RUDOLF VON WAGNER

WE have already briefly alluded to the loss suffered by chemistry in the sudden death from heart-disease of Prof von Wagner, which occurred at Wurzburg, October 4 Johannes Rudolf Wagner was born February 13, 1822, at Leipzig As a student in the university of his native city he made choice of chemistry as a profession, and supplemented the then somewhat limited advantages of the Leipzig laboratory by a course of study at Paris, whither students from numerous countries were attracted by the brilliant lectures and investigations of Dumas. His residence there was followed by a lengthy journey to the various centres of scientific interest in France, Belgium, Holland, and Germany, after which he returned in 1846 to Leipzig to accept a position as assistant in the chemical laboratory of the university. In 1851 he was appointed Extraordinary Professor of Technical Chemistry at the Nurnberg Polytechnic. In 1856 he accepted a call to the Chair of Technology at the University of Wurzburg, a position which he occupied until the time of his death. During this same time he also filled two important offices, that of Director of the Technological Conservatory at Wurzburg, and (until 1868) that of Royal Examiner of the establishments for Technical Instruction in Bavaria. His peculiar abilities and wide range of experience led to his being frequently sent abroad by the Bavarian Government on scientific missions, notably in 1858 to England and Holland, and in 1861 to Paris. The same reasons led to his being called upon to play an important *rôle* in the International Exhibitions of the past twenty years. He was successively appointed on the juries for chemical products at the Exhibitions of London (1862), Paris (1867), and Amsterdam (1869). At Vienna (1873) he was the Chief Commissioner of Bavaria, and at Philadelphia (1876) he was a leading member of the German Commission The marked services which he rendered in connection with the Vienna Exhibition were recognised by his sovereign, who raised him to the nobility, and decorated him with the Order of the Crown. Prof von Wagner was the recipient likewise of numerous decorations from most of the European countries

The career of Wagner has been one of unusual and varied activity. Apart from the multifarious duties of an executive character which we have briefly enumerated, he found time to render to pure chemistry, and especially to applied chemistry, services of incalculable value. Like Poggendorff in physics and Kopp in pure chemistry, his inclination led him towards the literary side of his favourite studies, and it is on his accomplishments as an author that his fame chiefly rests. Still, as an investigator Wagner possessed remarkable and many-sided aptitudes, and his name is associated with numerous researches, the majority of which aim at the practical application of scientific facts, or seek to ascertain the chemical nature of important industrial products One of his first investigations (1847) was on yeast, and included a thorough study of its nature and growth, and especially of the influence exercised by the presence of foreign bodies on the phenomena of fermentation In 1849 he commenced a research on the oil of rue, which was carried on at various intervals, and to which we owe much of our knowledge of the constituents of this important essence. In 1850 he assigned to the alkaloid conine the structure of a dibutyryl-amine, a formula verified long after by Schiff's synthesis (1871) of paraconine, and by Michael and Gundelach's brilliant synthesis a few months since, of methyl conine. Among other noteworthy theoretical results, mention may be made of his extensive monograph on polymeric isomorphism (1851), and his experiments in the same year establishing the nature of mercur-ammonium compounds as substituted ammonias—mercury replacing hydrogen—by a distillation of the well-known "white precipitate" with amyl-mercaptan, which yielded sulphide of mercury and hydrochloride of amylamine. Shortly after he showed that the compounds imperatorin and peucedonine obtained from the roots of sulphur-wort and allied plants were identical, and established their chemical nature as angelate of the hydrate of peucedyle. One of Wagner's most important researches, commenced in 1850 and taken up several times since, had for an object the colouring-matters of fustic. In its course he discovered morin-tannic acid, which in company with morin gives to fustic wood its tinctorial properties. He studied carefully its reactions and its derivatives, and among the latter discovered pyrocatechin, the product of the destructive distillation of the acid In 1853 he undertook a thorough examination of the oil of hops, separating the different chemical components, and finding amongst them quercitrin and morin-tannic acid At this epoch he succeeded in obtaining the remarkable alloy formed by the union of four parts of potassium with 2½ parts of sodium, which is liquid at ordinary temperatures, and resembles mercury in appearance. In 1867 he contributed an interesting research on the rapid increase of solubility of carbonates in water containing carbonic acid under various pressures. At the same time he broached a theory of the formation of deposits of a graphite, in which he attributed it to a decomposition of cyanides in nature analagous to that occurring in the manufacture of soda Among his more important analytical researches were the determinations (1860) of the quantities of oil present in the nuts and seeds of many forest trees. As an able deviser of analytical methods Wagner exhibited numerous proofs. Among these mention may be made of the use of the iodine reaction for analysing chlorides of lime (1859), the use of iodine likewise for the determination of the alkaloids (1861), the volumetric deter-

mination of tannic acid by means of sulphate of cinchonine (1866), the test for wool in silk fabrics by using nitro-prusside of sodium to show the presence of the sulphur contained in wool (1867), the application of ammonium vanadate to detect the presence of tannin in red wines (1877), and other tests for detecting methyl-eosine in the presence of eosine, nitrobenzene in the oil of bitter almonds, paraffine in bees-wax, stearic acid in paraffine, &c. Equally numerous were the improved methods of preparing chemical compounds and products introduced by him, including the preparation of pelargonate of ethyl, used extensively in perfumery, of finely-divided copper, of rufigallic acid, of calcium iodide, of precipitated alumina, of chloride of mercury, of arsenate of sodium, of benzoic acid, &c.

Among Wagner's purely technical researches reference may be made to the application of pyrocatechin for photographic purposes (1855), the determination of densities for technical use (1859), the method for purifying water for tinctorial purposes (1863), the use of paraffine for preserving sodium, and his important research (1877) on the reactions of vanadium compounds with a large variety of organic commercial products, in the course of which he obtained several important tinctorial results.

As an author Prof. von Wagner has manifested a degree of talent and a fertility surpassed by but few of his scientific contemporaries. An easy, lucid style, an intimate familiarity with the entire range of subjects touched upon, a fulness of detail united to a logical, systematic treatment of the matters in question, and a happy adaptation to the wants of even elementary knowledge, have rendered his works universal favourites. This is especially true of his "Handbook of Chemical Technology," which has survived a twelfth edition in Germany, and has been rendered accessible to French and English-speaking students by the masterly translations of Gautier and Crookes. It is doubtful whether in any other branch of applied science a manual exists which is so widely disseminated and has met with such practically universal success. Among Wagner's other works are "Die Chemie" (1860; sixth edition 1873), "Theorie und Praxis der Gewerbe," 5 vols (1857-64), "Die chemische Fabrikindustrie," second edition (1869), "Regesten der Sodafabrikation" (1866), and "Studien auf der Pariser Ausstellung" (1868). The technical journals of the past thirty years contain numerous monographs from his pen on individual branches of chemical manufacture, full of valuable information and statistics obtained by Wagner from private sources, and replete with those fruitful suggestions natural to a mind familiar at once with the facts of science and with their widespread applications. Unquestionably Wagner's chief literary achievement is his celebrated "Jahresbericht über die Leistungen der chemischen Technologie." Started eight years after the appearance of Liebig and Kopp's well-known "Jahresbericht" for chemistry in all its departments, this work of Wagner's has for a quarter of a century kept the industrial and scientific world promptly, thoroughly, and accurately informed of the progress made in every branch of applied chemistry. In its fulness and exactness it is an admirable type of the annual review, now regarded as indispensable for every branch of human activity by the German mind, and the vast influence which it has exercised upon the development of chemical industries is impossible to measure. The "Jahresbericht" for 1879, recently issued, forms a portly volume of 1,300 pages, with over one hundred woodcuts, and in its reviews evidences at every step a critical spirit able to cope with the scientific and practical questions constantly evoked.

Personally Prof. von Wagner was of a most attractive disposition, admired by his students not only for his rare talents as a lecturer, but also for his amiable character. His loss is felt as severely in a widespread social circle as in the world of science T. H. N.

JAPAN[1]

II.

MISS BIRD'S work on Japan, as we have said, is cast in quite a different mould from that of Sir Edward Reed. With the exception of one or two chapters, she devotes her two volumes entirely to a record of her own experiences, casting them as in her well-known books on the Sandwich Islands and the Rocky Mountains, into the form of a series of letters. These have evidently been written in the midst of the experiences which they record, and this gives them a reality and a freshness which they could not have otherwise had. Her "Unbeaten Tracks in Japan" has all the best characteristics of her book on the Sandwich Islands. Indeed it seems to us that for the majority of readers it will have far more of novelty and quite as much interest as any of her previous works, while we doubt if any other book on Japan yet published gives so full and real an insight into the everyday life and the condition of the bulk of the people. Her work well deserves the title it bears. Many of the districts into which she, amidst all sorts of difficulties, succeeded in penetrating were certainly never before visited by a European woman, if indeed by a European of either sex. Sir E. Reed speaks of the people along parts of his route rushing out to see the "Chinese" pass; but so strange and literally uncouth did Miss Bird's appearance seem in some districts that the people could only set her down as an "Aino." She of course saw all the usual sights in the usual tracks, all that Sir Edward Reed saw; and for this her intimacy with Sir Harry Parkes and his universally beloved lady procured her every facility. The result is not the almost unmixed admiration which we find in Sir Edward Reed's volumes; but then it should be remembered that she was not the guest of the Japanese Government, but practically of the representative of the English Government, and although Miss Bird is a thoroughly independent observer, still her opinions may have taken somewhat of their colour from her special surroundings. She states fully both sides of the question of Japanese progress, and while giving full credit to the Government for the best intentions, and admitting that vast progress has been made in recent years, still she has many drawbacks to point out And no wonder; we fear that she, like some others who write on Japan, look for too much, and expect to find a Europe in the East, instead of a country struggling out of the bonds that swaddled it till only fifteen years ago. Still her criticisms are wholesome, and charitable, and good-natured, and we trust that they will come under the notice of those to whom, if taken in good part, they might be greatly beneficial. Miss Bird has much to say on the work of missionaries in Japan, but that is a subject into which we cannot enter here. She spent much of her time in the great centres among missionaries, and had ample opportunities of seeing the nature of the work they are doing. And her observations are of the greatest interest, and must be instructive to those who are hoping that the Japanese will ultimately put on the religious habiliments which have been shaped for centuries to the people of the West One unfortunate result we may mention, and that is the deterioration of the manners of those who have been long under missionary influence. Surely this is not necessary.

Of course the great interest of Miss Bird's book is connected with her solitary journey, quite unhampered by official guidance, north through the centre of the Main Island, and most of all her sojourn in Yezo among the strange remnant of people known as Ainos. Her journey

[1] "Japan its History, Traditions, and Religions, with the Narrative of a Visit in 1879." By Sir Edward J. Reed, K.C.B., F.R.S., M.P. Two vols. With Map and Illustrations. (London: John Murray, 1880.) "Unbeaten Tracks in Japan." By Isabella L. Bird. Two vols. With Map and Illustrations. (Same Publisher.) Continued from vol. xxii. p. 614.

through the Main Island gives us the other side of the picture to that seen in such well-known centres as Tokio, Yokohama, and Kioto—by far the finest city in Japan, the home of art and culture, according to Miss Bird. She gives very sad and sometimes very disgusting pictures of the condition of the people in some parts of the country through which she passed with her amusing and clever guide Ito. In one district the villages, she tells us, have reached the lowest abyss of filthiness; still she found the people here, as everywhere else, courteous, kindly, industrious, and free from gross crimes. Indeed, although naturally an object of intense interest wherever she went, and the centre of hundreds and sometimes thousands of eyes, she had rarely if ever to complain of discourtesy. Everywhere everybody was courteous and obliging, and except in the open towns, rarely was an attempt at extortion made. While part of the centre of the island is dreary enough, much of it is of the rarest beauty, with its fine mountains, rich woods, and rapid deeply cutting rivers. At Niigata and other open ports she notes with satisfaction the rapid spread of European medical treatment under the care of the medical missionaries, some of whom are doing excellent work. At Niigata, especially Dr. Palm's influence is wide-spread, and thousands of people have been weaned from the Chinese system of treatment, to that offered by Dr. Palm and his numerous native assistants, most of them men of the best type, who have established among themselves a society similar to some of the medical societies which meet in London and elsewhere. At Niigata Miss Bird made the acquaintance of an interesting bookseller "This bookseller, who was remarkably communicative, and seems very intelligent, tells me that there is not the same demand now as formerly for native works on the history, geography, and botany of Japan. He showed me a folio work on botany in four thick volumes, which gives root, stalk, leaf, flower, and seed of every plant delineated (and there are 400), drawn with the most painstaking botanical accuracy, and admirable fidelity to colour. This is a book of very great value and interest. He has translations of some of the works of Huxley, Darwin, and Herbert Spencer, which, he says, are bought by the young men attending the higher school. The 'Origin of Species' has the largest sale. This man asked me many questions about the publishing and bookselling trade in England, and Ito acquitted himself admirably as an interpreter. He had not a single book on any subject connected with religion."

In a letter from Kaminoyama, to the north-east of Niigata, she gives a graphic picture of the incongruities to be met with in the present transition state of the country:—"We rode for four hours through these beautiful villages on a road four feet wide, and then, to my surprise, after ferrying a river, emerged at Tsukuno upon what appears on the map as a secondary road, but which is in reality a main road twenty-five feet wide, well kept, trenched on both sides, and with a line of telegraph poles along it. It was a new world at once. The road for many miles was thronged with well-dressed foot-passengers, *kurumas*, pack-horses, and waggons either with solid wheels, or wheels with spokes but no tires. It is a capital carriage-road, but without carriages. In such civilised circumstances it was curious to see two or four brown-skinned men pulling the carts, and quite often a man and his wife—the man unclothed, and the woman unclothed to her waist—doing the same. Also it struck me as incongruous to see telegraph wires above, and below, men whose only clothing consisted of a sun-hat and fan, while children with books and slates were returning from school, conning their lessons."

As far north as Kubota, quite 200 miles north of Niigata, Miss Bird found a normal school established, with

Fig. 1.—Ainos of Yezo

twenty-five teachers and 700 pupils between the ages of six and twenty "They teach reading, writing, arithmetic, geography, history, political economy after John Stuart Mill, chemistry, botany, a course of natural science, geometry, and mensuration." Indeed she found evidence everywhere of the schoolmaster being abroad all over the country, and of the purpose of the Government to make education, after the models of Europe and America, universal and compulsory; and among the educated classes, the familiarity with the works of the most advanced English scientific writers—Huxley, Darwin, and Spencer especially—struck her greatly.

To the ethnologist Miss Bird's notes on the Ainos, the

aborigines of the Island of Yezo, and possibly of all Japan, will prove of special interest. We already know much about the physique and the habits of these strange people; but Miss Bird's notes of what she saw and heard during the weeks she lived in their houses, saw their daily life, heard what they had to say of themselves, their history, and their superstitions, are a real addition to our existing knowledge of them. As usual all sorts of things were said by people in Hakodaté to prevent her from trusting herself alone among these uncivilised people, but Miss Bird took her own womanly way, and was rewarded These Ainos she found of fierce outer aspect, with their long shaggy hair and beards, broad faces, and rough bodies, but in speech and manner gentler than the gentlest Hawaiian. Their soft and feminine speech constantly struck her, and in genuine politeness they are not surpassed by the Japanese. Here is a picture of Aino domestic life:—

FIG 2.—Aino Houses.

"I am in the lonely Aino land, and I think that the most interesting of my travelling experiences has been the living for three days and two nights in an Aino hut, and seeing and sharing the daily life of complete savages' who go on with their ordinary occupations just as if I were not among them. I found yesterday a most fatiguing and over-exciting day, as everything was new and interesting, even the extracting from men who have few if any ideas in common with me, all I could extract concerning their religions and customs, and that through an interpreter. I got up at six this morning to write out my notes, and have been writing for five hours, and there is shortly the prospect of another savage *séance*. The distractions, as you imagine, are many. At this moment a savage is taking a cup of *saké* by the fire in the centre of the floor. He salutes me by extending his hands and waving them towards his face, and then dips a rod in the *saké*, and makes six libations to the god—an upright piece of wood with a fringe of shavings planted in the floor of the room. Then he waves the cup several times towards himself, makes other libations to the fire, and drinks. Ten other men and women are sitting along each side of the fire-hole, the chief's wife is cooking, the men are apathetically contemplating the preparation of their food, and the other women, who are never idle, are splitting the bark of which they make their clothes. I occupy the guest seat—a raised platform at one end of the fire, with the skin of a black bear thrown over it."

These Ainos drink enormous quantities of *saké*, the national liquor of Japan; they can drink three times as much as a Japanese without being affected by it, and the drinking of it is with them the chief act of worship to the rude gods, if gods they be, which are stuck up in various parts of their huts. Here is another picture —

FIG 3—Ainos at home (From a Japanese sketch).

"About nine the stew was ready, and the women ladled it into lacquer bowls with wooden spoons. The men were served first, but all ate together. Afterwards *saké*, their curse, was poured into lacquer bowls, and across each bowl a finely-carved '*saké-stick*' was laid. These sticks are very highly prized. The bowls were waved several time with an inward motion, then each man took his stick and, dipping it into the *saké*, made six libations to the fire, and several to the 'god,' a wooden post, with a quantity of spiral white shavings falling from near the top."

The intense fondness of the Ainos for their children is a marked feature in their character, and the instantaneous and implicit obedience of the latter to their parents is as great as with the Japanese themselves. Their hospitality is genuine, universal, and almost profuse. "In every house the same honour was paid to a guest. This seems a savage virtue which is not strong enough to survive much contact with civilisation. Before I entered one lodge the woman brought several of the finer mats, and arranged them as a pathway for me to walk to the fire upon. They will not accept anything for lodging or for anything that they give, so I was anxious to help them by buying some of their handiwork, but found even this a difficult matter. They were very anxious to give, but when I desired to buy they said they did not wish to part with their things. I wanted what they had in actual use, such as a tobacco-box and pipe-sheath, and knives with carved handles and scabbards, and for three of these I offered 2½ dollars. They said they did not care to sell them, but in the evening they came saying they were not worth more than 1 dollar 10 cents, and they would sell them for that; and I could not get them to take more. They said it was 'not their custom.'"

All that Miss Bird tells us of her visit to the Ainos is well worth quoting; but we have space for only one more quotation, and that with reference to their physique —

"After the yellow skins, the stiff horse hair, the feeble eyelids, the elongated eyes, the sloping eyebrows, the flat noses, the sunken chests, the Mongolian features, the puny physique, the shaky walk of the men, the restricted totter of the women, and the general impression of degeneracy conveyed by the appearance of the Japanese, the Ainos make a very singular impression. All but two or three that I have seen are the most ferocious-looking of savages, with a physique vigorous enough for carrying out the most ferocious intentions, but as soon as they speak the countenance brightens into a smile as gentle as that of a woman, something which can never be forgotten. The men are about the middle height, broad-chested, broad-shouldered, 'thick-set,' very strongly built, the arms and legs short, thick, and muscular, the hands and feet large. The bodies, and specially the limbs, of many are covered with short bristly hair. I have seen two boys whose backs are covered with fur as fine and soft as that of a cat. The heads and faces are very striking. The foreheads are very high, broad, and prominent, and at first sight give one the impression of an unusual capacity for intellectual development; the ears are small and set low, the noses are straight, but short, and broad at the nostrils; the mouths are wide, but well formed; and the lips rarely show a tendency to fulness. The neck is short, the cranium rounded, the cheek-bones low, and the lower part of the face is small as compared with the upper, the peculiarity called a 'jowl' being unknown. The eyebrows are full, and form a straight line nearly across the face The eyes are large, tolerably deeply set, and very beautiful, the colour a rich liquid brown, the expression singularly soft, and the eyelashes long, silky, and abundant. The skin has the Italian olive tint, but in most cases is thin, and light enough to show the changes of colour in the cheek. The teeth are small, regular, and very white, the incisors and 'eye teeth' are not disproportionately large, as is usually the case among the Japanese; there is no tendency towards prognathism; and the fold of integument which conceals the upper eyelids of the Japanese is never to be met with The features, expression, and aspect are European rather than Asiatic.

"The 'ferocious savagery' of the appearance of the men is produced by a profusion of thick soft black hair, divided in the middle, and falling in heavy masses nearly to the shoulders. Out of doors it is kept from falling over the face by a fillet round the brow The beards are equally profuse, quite magnificent, and generally wavy, and in the case of the old men they give a truly patriarchal and venerable aspect, in spite of the yellow tinge produced by smoke and want of cleanliness. The savage look produced by the masses of hair and beard, and the thick eyebrows, is mitigated by the softness in the dreamy brown eyes, and is altogether obliterated by the exceeding sweetness of the smile, which belongs in greater or less degree to all the rougher sex

"I have measured the height of thirty of the adult men of this village, and it ranges from 5 feet 4 inches to 5 feet 6½ inches. The circumference of the heads averages 22·1 inches, and the arc, from ear to ear, 13 inches. According to Mr. Davies the average weight of the Aino adult masculine brain, ascertained by measurement of Aino skulls, is 45·90 ounces avoirdupois, a brain weight said to exceed that of all the races, Hindoo and Mussulman, on the Indian plains, and that of the aboriginal races of India and Ceylon, and is only paralleled by that of the races of the Himalayas, the Siamese, and the Chinese Burmese. Mr. Davies says, further, that it exceeds the mean brain weight of Asiatic races in general. Yet with all this the Ainos are a stupid people!"

The coast Ainos, Miss Bird tells us, she found had more hair on their bodies than those in the interior, and in some other respects differed in appearance, a difference probably to be accounted for by their mode of life and their surroundings. The Aino garments are often exceedingly handsome, being decorated with "geometrical" patterns in which the Greek fret takes part, in coarse blue cotton, braided most dexterously with scarlet and white thread. The modesty of the women is very remarkable, sometimes almost excessive even to European notions, nor do they seem to be the unmitigated drudges that most savage women are. The great hero of the Ainos is Yoshitsuné, who is also the most popular hero of Japanese history; the Ainos worship him, and Miss Bird was permitted to visit his shrine on a hill near Biratori, the Aino village at which she spent most of her time. He lived in the twelfth century, and was the brother of the Shôgun of the time, whose jealousy, according to some, compelled him to take refuge in Yezo. "None believe this more firmly than the Ainos themselves, who assert that he taught their fathers the arts of civilisation, with letters and numbers, and gave them righteous laws, and he is worshipped by many of them under a name which signifies Master of the Law I have been told by old men in Biratori, Usu, and Lebungé, that a later Japanese conqueror carried away the books in which the arts were written, and that since his time the arts themselves have been lost, and the Ainos have fallen into their present condition! On asking why the Ainos do not make vessels of iron and clay as well as knives and spears, the invariable answer is, 'The Japanese took away the books.'" This, combined with some other things which Miss Bird tells us of these Ainos, makes it seem quite possible that they are now a degenerate remnant of a people who formerly were comparatively cultured, and who may possibly have had "books" which the Japanese, their conquerors and masters, "took away." These strange people are certainly worthy of further study. The illustrations we are able to give, by the kindness of Mr. Murray, will give the reader some idea of their appearance and habits. We strongly recommend the reader to go to Miss Bird's volumes for further information of what she saw and heard while sojourning among them.

Again we commend these two works to all who desire to get, in comparatively short space, a very complete view of the past history and present condition of Japan.

BELL'S PHOTOPHONE

By the courtesy of Prof. Graham Bell we are at length able to do somewhat ampler justice to his latest discovery than has hitherto been possible. He has supplied us with certain details not hitherto published, and has also furnished us with drawings of his apparatus and experiments. Prof Bell is at present in Paris, and, as was mentioned in our columns last week, has there repeated some of his experiments.

Our readers are already aware that the object of the photophone is the transmission of sounds both musical and vocal to a distance by the agency of a beam of light of varying intensity; and that the first successful attempts made by Prof. Bell and his co-labourer, Mr. Sumner Tainter, were based upon the known property of the element selenium, the electric resistance of which varies with the degree of illumination to which it is exposed Hence, given a transmitting instrument such as a flexible mirror by which the vibrations of a sound could throw into vibration a beam of light, a receiver consisting of sensitive selenium forming part of an electric circuit with a battery and a telephone should suffice to translate the varying intensities of light into corresponding varying intensities of electric current, and finally into vibrations of the telephone disk audible once more as *sound*. This funda-

mental conception dates from 1878, when in lecturing before the Royal Institution Prof. Bell announced the possibility of hearing a shadow fall upon a piece of selenium included in a telephone circuit. The photophone, however, outgrew the particular electrical combination that suggested it; for not the least of the remarkable points in this research is the discovery that audible vibrations are set up in thin disks of almost every kind of

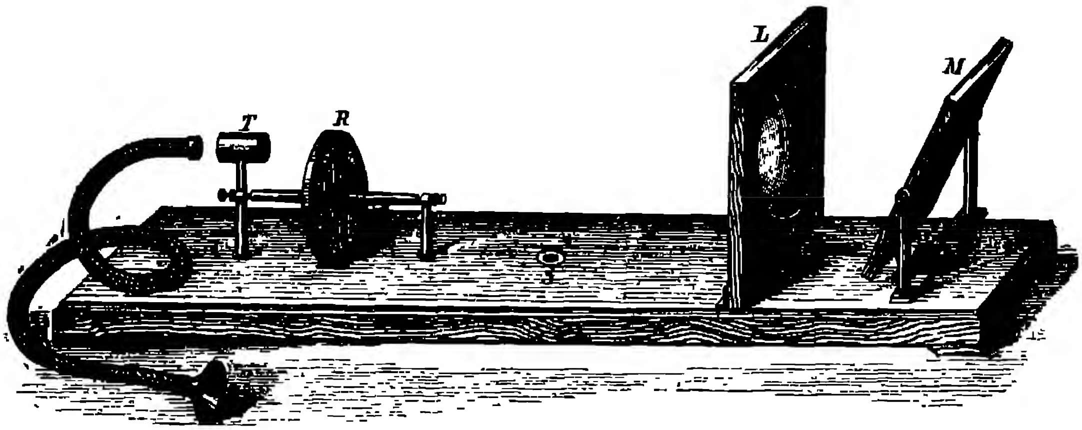


FIG 1.—The Musical Telephone

material by merely throwing upon them an intermittent light. Hence in theory, if not in practice, the receiver may be reduced to the divine simplicity of a mere disk of

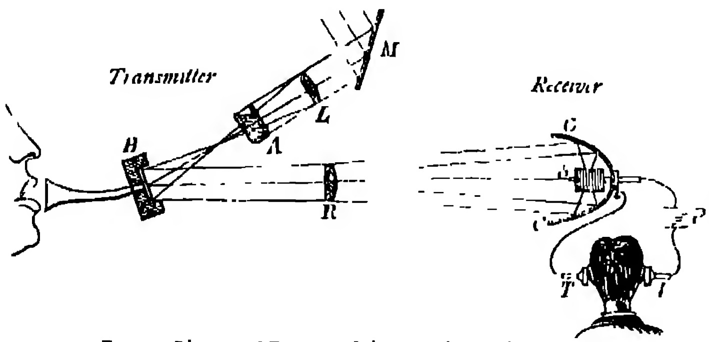


FIG 2.—Theoretical Diagram of the Articulating Photophone

vulcanite or of zinc, on one side of which the vibrating beam of light falls, and at the other side of which the hearer listens.

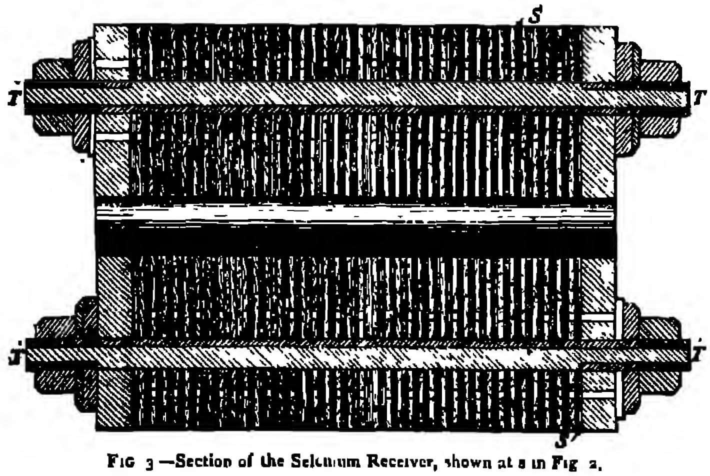


FIG 3.—Section of the Selenium Receiver, shown at s in Fig 2.

With the photophone, however, as with the telephone, there are instruments of different degrees of perfection. The original imperfect musical telephone of Philip Reis could only transmit musical tones, because it worked by rapid abrupt interruptions of the electric current; while the articulating telephone of Graham Bell was able to transmit speech, since by its essential construction it was able to send undulating currents to the distant receiving station.

We may in like manner classify the forms of photophone under two heads, as (1) articulating photophones, and (2) musical photophones; the former being able to transmit speech because they work by beams of light whose intensity can vary in undulatory fluctuations, like those of vocal tones; the latter being able to transmit simple musical tones only, since they work by mere interruptions of a fixed beam of light.

Up to the present time, Prof. Bell informs us, the simple receiving disk of ebonite or hard rubber has only served for a musical photophone: the reproduction of the tones of the voice by its means has not yet been demonstrated in practice—at least to his satisfaction. For while it produces unmistakable musical tones by the direct action of an intermittent light, in the experiments made hitherto with articulate speech the instruments have by necessity been so near to one another that the voice of the speaker was audible through the air. Under these circumstances it is extremely difficult to say whether the sounds that are heard proceed from the diaphragm, or whether they merely came through the air to the ear, and if they come from the diaphragm, whether they are really the result of the varying light, and not mere sound vibrations taken up by the disk from the speaker's voice crossing the air. Prof Bell hopes soon to settle this point, however, by an appeal to experiment on a larger scale with the receiving and transmitting instruments at greater distances apart, and with glass windows in between to shut off all sounds.

In Fig. 1 we illustrate the simple musical photophone of Bell and Tainter. It might perhaps be described without injustice as an *optical siren*, producing sounds from intermittent beams of light, as the *siren* of Cagniard de Latour produces them from intermittent puffs of air. A beam of light from the sun or from a powerful artificial source, such as an electric lamp, falls upon a mirror M, and is reflected through a large lens L, which concentrates

the rays to a focus. Just at the focus is interposed a disk pierced with holes—forty or so in number—arranged in a circle. This disk can be rotated so that the light is interrupted from one to five or six hundred times per second The intermittent beam thus produced is received by a lens T, or a pair of lenses upon a common support, whose function is to render the beam once more parallel, or to concentrate it upon the disk of ebonite placed immediately behind, but not quite touching them. From the disk a tube conveys the sounds to the ear. We may remind our readers here that this apparent direct conversion of light into sound takes place, as Prof. Bell found, in disks of all kinds of substances—hard rubber, zinc, antimony, selenium, ivory, parchment, wood, and that he has lately found that disks of carbon and of thin glass, which he formerly thought exceptions to this property, do also behave in the same way. We may perhaps remark without impropriety that it is extremely improbable that the apparent conversion of light into sound is by any means a direct process. It is well known that luminiferous rays, when absorbed at the surface of a medium, warm that surface slightly, and must therefore produce physical and molecular actions in its structure. If it can be shown that this warming effect and an intermediate cooling by conduction can go on with such excessive rapidity that beams of light falling on the surface at intervals less than the hundredth of a second apart produce a discontinuous molecular action of alternate expansion and contraction, then the mysterious property of matter revealed by these experiments is accounted for.

However this may be, the musical photophone, as represented in Fig. 1, produces very distinct sounds, of whose existence and dependence for their production on the light the listener may satisfy himself by cutting off the light at any moment with the little opaque disk fixed on the end of the little lever just in front of the holes in disk R, and which can be worked by a Morse key like a telegraph instrument, thus producing at will alternate sounds and silences. With this musical photophone sounds have been carried by an interrupted beam of light for a distance exceeding a mile, there appears, indeed, no reason why a much greater range might not be attained.

The articulating photophone is that to which hitherto public attention has been most largely directed, and in which a selenium receiver plays a part. Fig 2 gives in diagram form the essential parts of this arrangement A mirror M reflects a beam of light as before through a lens L, and (if desired for the purpose of experimentally cutting off the heat-rays) through a cell A containing alum-water, and casts it upon the transmitter B. This transmitter, shown again in Fig 5, consists of a little disk of thin glass, silvered on the front, of about the size of the disk of an ordinary telephone, and mounted in a frame, with a flexible india-rubber tube about sixteen inches long leading to a mouthpiece A second lens R, interposed in the beam of light after reflection at the little mirror, renders the rays approximately parallel The general view of the transmitting apparatus given in Fig. 5 enables the relative sizes and positions of the various parts (minus the alum-cell which is omitted) to be seen The screw adjustments of the support serve to direct the beam of light in the desired direction.

It may be well to explain once for all *how* the vibrations of the voice can affect the intensity of the reflected beam far away The lenses are so adjusted that when the mirror B is flat (*i.e.* when not vibrating) the beam projected from the apparatus to the distant station shall be nearly focussed on the receiving instrument. Owing to the optical difficulties of the problem it is impossible that the focussing can be more than approximate. Now, matters being thus arranged, when the speaker's voice is thrown against the disk B it is set into vibration, becomes alternately bulged out and in, and made slightly convex or concave, the degree of its alteration in form varying with every vibration of the voice Suppose at any instant —say by a sudden displacement such as takes place when the letter "T" is sounded—the disk becomes considerably convex, the beam of light will no longer be concentrated upon the receiving instrument, but will cover a much wider area Of the whole beam, therefore, only a relatively small portion will fall upon the receiving instrument, and it is therefore possible to conceive that, if perfectly adjusted, the illumination should be proportional to the displacement of the disk, and vary therefore with every vibration with the utmost fidelity

The receiver of the articulating photophone is shown on the right-hand side of the diagram (Fig. 2) sketched by Prof Bell A mirror of parabolic curve C C serves to concentrate the beam and to reflect it down upon the selenium cell S, which is included in the circuit of a battery P along with a pair of telephones T and T. Here again a general view like that given in Fig. 6 facilitates the comprehension of the principal parts of the apparatus The sensitive selenium cell is seen in the hollow of the parabolic mirror which is mounted so as to be turned in any desired direction. The battery standing upon the ground furnishes a current which flows through the selenium cell and through the telephones. When a ray of light falls on the selenium—be it for ever so short an instant—the selenium increases in conductivity, and instantly transmits a larger amount of electricity, and the observer with the telephones hears the ray, or the succession of them;—hears

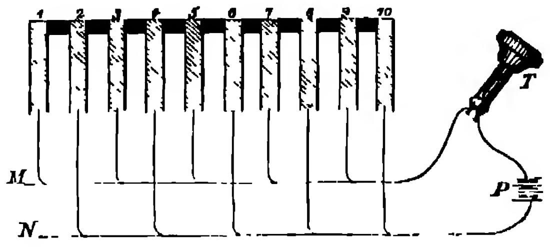


FIG 4—Diagram to show the action of the Selenium Receiver

indeed their every fluctuation in a series of sounds which, since each vibration corresponds to a vibration of the voice of the distant speaker, reproduce the speaker's tones

The great difficulty to be overcome in the use of selenium as a working substance arose from its very high resistance To reduce this to the smallest possible quantity, and at the same time to use a sufficiently large surface whereon to receive the beam of light, was the problem to be solved before any practical result could be arrived at After many preliminary trials with gratings and perforated disks of various kinds, Prof. Bell and Mr Tainter finally settled upon the ingenious device to be described A number of round brass disks, about two inches in diameter, and a number of mica disks of a diameter slightly less, were piled upon one another so as to form a cylinder about two and a half inches in length They were clamped together from end to end, the clamping rods also serving to unite the disks of brass electrically in two sets, alternate disks being joined, the 1st, 3rd, 5th, &c., being united together, and the 2nd, 4th, 6th, &c, being united in another series This done, the edges between the brass disks were next filled with selenium, which was rubbed in at a temperature sufficiently high to reach the melting-point of selenium After this the selenium was carefully annealed to bring it into the sensitive crystalline state. Then the cell is placed in a lathe and the superfluous selenium is turned off until the edges of the brass disks are bared. Fig. 3 shows, in section, the construction of such a cell Prof. Bell has also used cells in which the selenium filled only the *alternate* spaces between disks, the intermediate spaces being occupied by

mica disks of equal diameter with the brass disks. But this arrangement was in no way preferable, for in practice

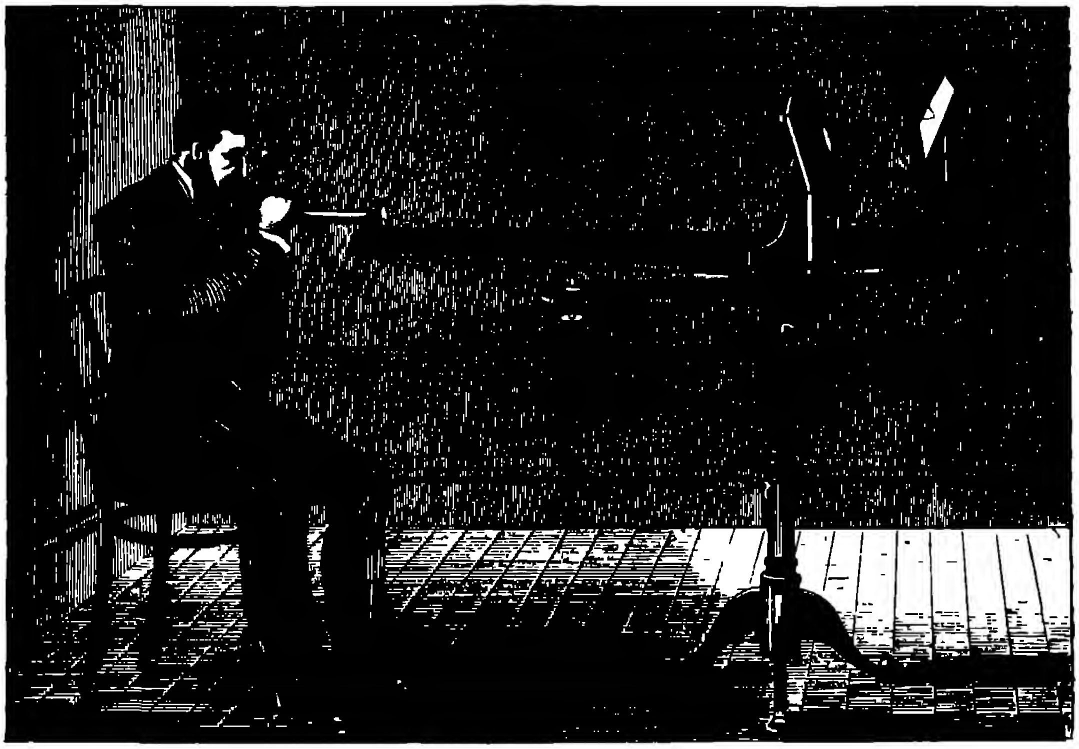


FIG. 5.—The Articulating Photophone. The Transmitter

it was found that moisture was apt to penetrate at the surface of the bare mica, spoiling the effect.

Fig. 4 is a diagram which simply illustrates the action of the selenium receiver, and shows, firstly, the way of

FIG. 6.—The Articulating Photophone. The Selenium Receiver

connecting the alternate disks; and secondly, that the current from the battery P cannot go round the telephone

circuit without passing somewhere through selenium from one brass disk to the next. The special advantages of the "cell" devised by Prof. Bell are that in the first place the thickness of the selenium that the current must traverse is nowhere very great; that in the second, this photo-electrical action of light on selenium being almost entirely a *surface* action, the arrangement by which all the selenium used is a thin surface film could hardly be improved upon, and that thirdly, the symmetry of the cylindrical cell specially adapts it for use in the parabolic mirror. These details will be of great interest especially to those who desire to repeat for themselves the experimental transmission of sound by light. The greatest distance to which articulate speech has yet been transmitted by the selenium-cell-photophone is 213 metres, or 233 yards.

When sunlight is not available recourse must be had to an artificial source of sufficient power During the recent experiments made by Prof. Bell in Paris the weather has been adverse, and the electric light has been called into requisition in the *ateliers* of M Biegnet (Fig 7, which is kindly supplied us by Prof. Bell). The distance in these experiments between the transmitting diaphragm B and the parabolic reflector C C of the receiver was fifteen metres, the entire length of the room in which

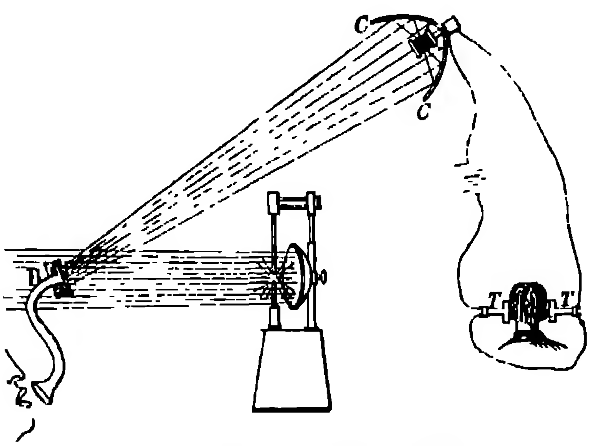


FIG 7—The Photophone with Electric Light

the experiments were made. Since at this distance the spoken words were themselves perfectly audible across the air, the telephones connected with the selenium-cell were placed in another apartment, where the voices were heard without difficulty and without doubt as to the means of transmission.

Of the earlier and less perfect forms of the photophone little need be said. One device, which in Prof. Bell's hands worked very successfully over a distance of eighty-six yards, consisted in letting the beam of light pass through a double grating of parallel slits lying close to one another, one of which was fixed, the other movable and attached to a vibrating diaphragm. When these were placed exactly one in front of the other the light could traverse the apparatus, but as the movable grating slid more or less in front of the fixed one more or less of the light was cut off. Speaking to the diaphragm therefore caused vibrations which shut or opened, as it were, a door for the beam of light, and altered its intensity. The mirror transmitter of thin glass silvered was however found superior to all others; and it is hard to see how it could be improved upon, unless possibly by the use of a thin disk of silver itself accurately surfaced and polished.

Whatever be the future before the photophone, it assuredly deserves to rank in estimation beside the now familiar names of the telephone and the phonograph.

NOTES

THE Triennial Gold Medal of the Chemical Section of the Philosophical Society of Glasgow, founded in commemoration of the work of Thomas Graham, F R.S., late Master of the Mint, will be awarded, at the end of the present session, for the best paper on any subject in pure or applied chemistry Authors are requested to send in their papers not later than February 1, 1881, addressed to the Secretary of the Section, Dr J J. Dobbie, Chemical Laboratory, University of Glasgow

THE annual meeting of the five academies which constitute the French Institute was held on Monday last week, when M. E. Levasseur gave an address on the Ethnography of France, and Col. Perrier described the operation he undertook to connect geodetically Algeria and Spain.

THE Royal Institution Lecture arrangements (not yet complete) for the ensuing season (before Easter) will include the Christmas course by Prof. Dewar, and courses by Professors Tyndall and Schafer, the Rev. William Haughton, the Rev. H. R. Haweis, Mr. H. H. Statham, Mr. Reginald S. Poole, and others Friday Evening Discourses will probably be given by Mr Warren De La Rue, Prof. Tyndall, Sir John Lubbock, Sir William Thomson, Dr. J Burdon Sanderson, Dr Andrew Wilson, Dr Arthur Schuster, Mr. Alexander Buchan, Dr. W H. Stone, Dr. W. J. Russell.

THE death is announced of Sir Thomas Bouch, the engineer of the Tay Bridge. It is believed that his system received a severe shock on account of the Tay Bridge disaster and the proceedings consequent on it.

M. ERHARD, the well known French cartographer, died on October 23 M. Erhard was a naturalised Frenchman, having been born at Freiburg im-Breisgau.

AMONG Mr. Stanford's announcements of forthcoming works are the following:—"Prehistoric Europe: a Geological Sketch," by Dr. James Geikie, F.R.S.; a fourth edition of "The Coal-Fields of Great Britain," by Prof. Edward Hull, F.R.S., "Life and her Children: Glimpses of Animal Life from the Amœba to the Insects," by Arabella B. Buckley, "Index Geographicus Indicus a Gazetteer of India," by J F Barness, "The Flora of Algeria, considered in Relation to the Physical History of the Mediterranean Region and Supposed Submergence of the Sahara," by W. Mathews, "Water Supply of England and Wales its Geology, Underground Circulation, Surface Distribution, and Statistics," by C E. de Rance.

IN the November number of *Scribner's Monthly* is a curious article on Second Sight or Clairvoyance, by an "Ex-Conjuror" (Mr Henry Hatton), in which it is shown that the whole thing is an elaborate system of mnemonics. The article has all the appearance of being genuine.

IN reference to the notice in NATURE, vol. xxii. p 587, on the address of Dr. Karl Zittel on the subject of the geology of the Libyan Desert, we should state that while the paper contains Zittel's opinions of the observations and collections of other travellers, it is mainly derived from the Professor's personal examination of the physiography of that country, and of the fossils which he there collected, when, as a member of the expedition under the leadership of Dr. Rohlfs, he visited the Libyan Desert in the winter of 1873-74

THE lecture on "The Modifications of the External Aspects of Organic Nature produced by Man's Interference," delivered by Prof. Rolleston to the Royal Geographical Society in 1879, has just been published in that Society's *Journal*. Amongst other interesting matters Prof. Rolleston rectifies an error into which all or most translators of Cæsar have fallen respecting

the Scotch fir. Cæsar ("De Bello Gallico," v. 12) says of Britain, "Materia cujusque generis, ut in Gallia, est *præter fagum atque abietem*," which words have been generally taken to mean, "There is wood of all kinds to be found in Britain, as in Gaul, *except* the beech and the fir." The word *præter* however does not always mean "except," but sometimes "besides," as quotations from Cicero and Plautus aptly illustrate. Prof. Rolleston further remarks that "an historian who was or was not a professed botanist, might without any sensible man blaming him, speak nowadays of all the common pines 'Scotch,' 'umbrella,' 'cluster,' &c., as 'pines'; my present belief is that Julius would similarly have spoken of them all as *abietes*, and would probably have included the 'firs' proper under the same name as these 'pines.'"

At the last meeting of the Epping Forest and County of Essex Naturalists' Field Club, held Saturday, October 30, it was announced that H.R.H. the Duke of Connaught, Ranger, had consented to become the Patron of the Club. Arrangements are being made to get up a course of winter science lectures in connection with the Club, the first of these being fixed for November 10, by Mr. J. E. Harting, who will lecture on "Forest Animals." It was further announced that a lecture had been promised during the session by Mr. A. R. Wallace.

Prof. Boyd Dawkins has lately shown in his "Early Man in Britain" that "although the Neolithic men were immeasurably above the Cave men in culture, they were far below them in the arts of design," and further that the Cave-man "possessed a singular talent for representing the animals he hunted, and his sketches reveal to us that he had a capacity for seeing the beauty and grace of natural form not much inferior to that which is the result of long-continued civilisation in ourselves, and very much higher than that of his successors in Europe in the Neolithic age." That this faculty of design or artistic aptitude is still independent of advanced or advancing civilisation is shown by Dr. Holub in a paper "On the Central South African Tribes," just published in the *Journal* of the Anthropological Institute. Mr. Holub remarks in connection with the Bushmen, that these people "regarded as the lowest types of Africans, in one thing excel all the other South African tribes whose acquaintance I made between the south coast and 10° south latitude. I have in my possession about 200 sketches on wood and stone and ostrich shells, by various tribes, but every one who knows anything about drawing must acknowledge that those which were done by Bushmen are superior to any of the others."

It is stated that some samples of a new seed and also of the native cucumber, collected in Central Australia by Mr. Vesey Brown, have been received at the Sydney Botanical Gardens. The former is a small black pea, which grows in pods similar to those of the ordinary pea, it is supposed to be edible, and resembles the nardoo. The cucumbers are about the size of walnuts, and are said to make an excellent pickle.

A recent report to the Foreign Office by Mr. Consul Crawford at Oporto on matters connected with the wine trade contains observations on the ravages of the parasitic insect, *Phylloxera vastatrix*, in the port wine district, and the means taken to avert them, and is illustrated by a sketch map of Northern Portugal, showing the progress of the disease.

At the opening meeting of the Eastbourne Natural History Society on October 15, Mr. F. C. S. Roper read a paper on the additions to the fauna and flora of the Cuckmere district during the past year.

In the Fourteenth Annual Report of the Aeronautical Society of Great Britain are papers on Aeronautics, by Mr. T. Moy, the "Mechanical Action of the Air," by Mr. Phillips; "Artificial Flight," by Mr. F. W. Brearey, "Aerial Propellers," by Mr. R. C. Jay.

Valparaiso advices to August 21 give particulars of the earthquake of August 14. The *Chilian Times* says:—"The duration of the shock was nearly ninety seconds. No serious damage was done to buildings in Valparaiso. At Vina del Mar, one of the towers of the church fell and another was shaken out of its level, and will probably have to be pulled down. The roof of the Quillota parish church fell in. At Llaillai eighteen or twenty houses were destroyed. Illapel suffered very severely. One strange item reported is the occurrence of 'huracane de agua,' whatever they may be. The Governor of Illapel in his first telegram stated that three of these had burst in the Cordillera. Now it is stated that there were thirty observed. One paper spoke of them as 'water volcanoes.' From Coquimbo it is reported that high columns of water were thrown up from the bay. An *employé* of the Transandine Telegraph Company felt the shock while crossing the highest parts of the Andes. He states that it was the strongest earthquake he has ever felt."

A Naples telegram of November 2 states that Vesuvius is now very active; lava continues to flow from the crater, and present indications point to the probability of increased eruptive energy.

The first meeting of the Society of Arts is announced for November 17, when the opening address will be delivered by F. J. Bramwell, F.R.S., Chairman of the Council. Before Christmas the following papers will be read:—November 24—"Barry's Influence on English Art," by J. Comyns Carr. December 1—"The Photophone," by W. H. Preece. December 8—"London Fogs," by Dr. A. Carpenter. December 15—"The Use of Sound for Signals," by E. Price Edwards. The following papers are down on the list for reading after Christmas:—"Buying and Selling: its Nature and its Tools," by Prof. Bonamy Price. "The Participation of Labour in the Profits of Enterprise," by Sedley Taylor, M.A., late Fellow of Trinity College, Cambridge. "The Gold Fields of India," by Hyde Clarke. "Flashing Signals for Lighthouses," by Sir William Thomson, F.R.S. "The Present Condition of the Art of Wood-carving in England," by J. Hungerford Pollen. "Ten Years' Experience of the Working of the Trade Mark Act," by E. C. Johnson. "Trade Prospects," by Stephen Bourne. "The Manufacture of Aerated Waters," by T. B. Bruce Warren. "The Compound Air Engine," by Col. F. Beaumont, R.E. "Improvements in the Treatment of Esparto for the Manufacture of Paper," by William Arnot, F.C.S. "Deep Sea Investigation, and the Apparatus used in it," by J. Y. Buchanan. "The Discrimination and Artistic Use of Precious Stones," by Prof. A. H. Church. "Indian Agriculture," by W. R. Robertson. Five courses of lectures are announced under the Cantor bequest. First course—Five lectures on "Some Points of Contact between the Scientific and Artistic Aspects of Pottery and Porcelain," by Prof. A. C. Church. Second Course—Three lectures on "Watchmaking," by Edward Rigg, M.A. Third course—Four lectures on "The Scientific Principles involved in Electric Lighting," by Prof. W. G. Adams, F.R.S. Fourth course—Three lectures on "The Art of Lace-making," by Alan S. Cole. Fifth course—Three lectures on "Colour Blindness and its Influence upon Various Industries," by R. Brudenell Carter. The two Juvenile Lectures, for children of Members, during the Christmas holidays, will be by G. J. Romanes, F.R.S., on "Animal Intelligence." The arrangements for the "Indian," "Foreign and Colonial," and "Chemical and Physical" Sections will be announced after Christmas.

The following is the title of the essay to which the "Howard Medal" of the Statistical Society will be awarded in November,

1881:—"On the Jail Fever, from the earliest Black Assize to the last recorded outbreak in recent times." The essays to be sent in on or before June 30, 1881. The Council have decided to grant the sum of 20*l.* to the writer who may gain the "Howard Medal" in November, 1881.

THE additions to the Zoological Society's Gardens during the past week include a Sykes's Monkey (*Cercopithecus albigularis*) from West Africa, presented by the Officers of the Royal Yacht, a Green Monkey (*Cercopithecus callitrichus*) from West Africa, presented by Mr. A. Haynes; a Rhesus Monkey (*Macacus erythræus*) from India, presented by the Rev. J. Saunders, B.A.; a Two-toed Sloth (*Cholopus didactylus*) from Demerara, presented by Mr. G. H. Hawtayne, C.M.Z.S.; an Egyptian Jerboa (*Dipus ægyptius*) from Egypt, presented by Major Money; a Common Trumpeter (*Psophia crepitans*) from Demerara, presented by Mr. J. Stovell; two Silver Pheasants (*Euplocamus nycthemerus*) from China, presented by Miss C. Hallett, an Indian Gazelle (*Gazella bennetti*) from India, deposited, an Ursine Dasyure (*Dasyurus ursinus*) from Tasmania, a Common Wigeon (*Mareca penelope*), a Grey Plover (*Squatarola helvetica*), a Knot (*Tringa canutus*), a Greenshank (*Totanus cadidris*), British, a Horned Ceratophrys (*Ceratophrys cornuta*) from Santa Marta, purchased.

OUR ASTRONOMICAL COLUMN

THE COMETS OF 1812 AND 1815.—We learn from M. Schulhof, of the Bureau des Longitudes, Paris, that in conjunction with M. Bossert he has undertaken a rigorous investigation of the orbit of the comet of 1812, which Encke showed to have a period of about seventy years, and which will consequently be again approaching its perihelion. M. Schulhof hopes to complete the calculations early in the ensuing year. He has discovered a series of original observations by Blanpain at Marseilles, which he considers to be amongst the best, if not the best series that are available; the original observations by Lindenau have also been received, but unfortunately nothing is to be found of the long series by Zach and Triesnecker. From the manuscripts preserved at Paris some corrections have been applicable to the results as printed. To this we may add that Flaugergues' differences of right ascension and declination from his comparison stars are published in the fifth volume of Zach's *Correspondance astronomique*. These observations of Flaugergues' at Viviers, and those made at Paris as they appear in the first folio volume, were reduced several years since by Mr. W. E. Plummer, now of the University observatory, Oxford, and from three very carefully formed normals he deduced a period of revolution about a year and a half shorter than that assigned by Encke in *Zeitschrift für Astronomie*, t. ii., so that the comet may now be expected at any time. At the instance of Prof. Winnecke sweeping ephemerides have been prepared by M. Mahn of Strassburg. It is however M. Schulhof's intention, on the completion of his investigation of the orbit, to furnish observers with ephemerides similar to those which have led to the re-discovery of several lost planets.

An able calculator at Vienna has nearly finished a new discussion of the observations of the comet of 1815 (Olbers' comet), which, according to Bessel's researches, is due at perihelion in February, 1887. This result may be materially changed by the more complete reduction of such series of observations as we possess in their original form, and a recomputation of the perturbations, with more accurate values of the planetary masses than were available at the date of Bessel's work.

CERASKI'S CIRCUMPOLAR VARIABLE STAR.—From the estimated magnitudes of Schwerd and Carrington, and Mr. Knott's epoch of minimum given in NATURE last week, the most probable period appears to be 2·49085d., to be reckoned from 1880, October 23·4672 Greenwich mean time. While the telescope is turned towards Ceraski's star, it may be suggested that Lalande 1013-4 in Cassiopeia should receive attention; at present we have the discordant estimates 10m. and 5m. of Lalande, 1790 September 29, and 1797 November 10 respectively, and 7·7 in the *Durchmusterung*; the star is 6m. on Harding's Atlas, and is not found in Fedorenko's catalogue, or in Argelander's zones; its position for 1880 is in R.A. 0h. 33m. 22s., N.P.D. 38° 46·8′.

THE LONGITUDE OF THE CAPE.—We understand that arrangements are being made for the telegraphic connection of the Royal Observatory, Cape of Good Hope, with Aden, which has already been connected with Greenwich, Mr. Gill taking an active part in the operation. The next desirable work of this kind will be the connection of an Australian observatory with the observatory at Madras, which is well-determined with reference to Greenwich.

GEOGRAPHICAL NOTES

COL. PREJEVALSKY writes from "Houi-de-Tin, plateau of the Hoang-ho, May, 1880." Having packed up and sent off all his collections to Alashan, he left his camp, 25 versts from the town of Donkyr, on March 20, to reach the Hoang-ho, 83 versts from Donkyr. Here the Yellow River turns abruptly from north-east to east, at the small valley of Gomi, inhabited by Tungut cultivators, and forming the extreme point of the habitable lands of the Hoang-ho. The river here is pretty wide, and has a very rapid current. The banks are wooded, with here and there pretty clumps of poplars and weeping willows. The river here is 8,000 feet above sea-level. After ten days at Gomi, Prejevalsky's party resumed their route. From Gomi the journey along the Hoang-ho was very difficult, the banks being deeply cut by steep ravines, which can only be noticed when close upon them. A stream usually flows at the bottom of these ravines, which are bordered by trees and wild arbutus. As soon as ever the party touched the Si-Fan territory a horseman appeared and, telling them they would soon be murdered, disappeared—a threat happily not realised. Indeed the Si-Fan became so reconciled to the presence of the intruders as to sell them butter and sheep. At 130 versts from Gomi they found in the ravines bordering the river vast forests frequented by innumerable birds, especially blue pheasants. The second local rarity was rhubarb, which was met with in prodigious quantities. The old roots of this plant reach colossal proportions. One of these roots, taken at hazard, weighed 26 lb. The mouth of the Churmysh, an affluent of the Hoang-ho, was reached 130 versts below Gomi, by the course of the river. Having examined the country for a distance of 40 versts, Prejevalsky was convinced that it was impossible to cross the enormous chain of mountains which extends along the Yellow River, the summits of which are lost in the clouds. Gaping ravines are met with at every verst, and there is not the least trace of vegetation, and therefore no forage for animals. He decided to return to Gomi. Thence he went to Houi-De, 60 versts on the south bank of the river, and sent his interpreter to Sinin to inform the local authorities that Prejevalsky wished to reach the mountain regions of eternal snow. The Amban of Sinin informed Prejevalsky that it was impossible to allow him to proceed to the Koko-nor, or to penetrate further into Houi-De, where there was a revolt of the Tunguts. Prejevalsky decided to spend the month of June where he was, exploring the fauna and flora, and afterwards go north towards Cheibsen, where he would remain during July, and complete his explorations in the mountains. The weather, he says, was detestable, cold and wet, with the thermometer sometimes 12° below zero C. He had collected 250 specimens of plants, 500 species of birds, and many of fish. The geography of the country traversed had, moreover, been observed and noted, astronomical, barometrical, and thermometrical observations made, and sketches taken of the various types of natives. He doubts much whether the Hoang-ho makes the enormous curve represented in maps, he did not observe any such curve in the 250 versts explored by him. He expected to reach Alashan about August 20.

IN the Geographical Society's *Proceedings* for November Mr. C. R. Markham supplies a brief but lucid account of Lieut. Schwatka's expedition to King William Land, and of the previous state of our knowledge respecting the remains, &c., of the Franklin Expedition, and he arrives at the conclusion that we have gained but little by this last attempt to obtain information beyond that gathered by Sir L. McClintock. Lieut. Schwatka's journey, however, he considers to have been a most remarkable one, and in some respects without a parallel. Dr. Christison follows with a paper descriptive of a journey made some twelve years ago to Central Uruguay. The geographical notes are numerous this month, and furnish much useful information, especially in regard to Africa. Under the head of "Corre-

spondence" we find letters by Adm. R. C. Mayne on a possible communication between Skyring Water, Straits of Magellan, and Smyth's Channel, and by Capt. Alexanderson on the subject of some observations made during a recent voyage along the Loango Coast of West Africa. The maps given this month are of King William Land and the Estancia de San Jorge, Uruguay, with a small inset map of the whole republic.

As we announced last week, the Vienna Geographical Society has issued an appeal for subscriptions for an Austrian expedition, which Dr. Emil Holub has decided on undertaking. Dr. Holub intends crossing the whole length of Africa from south to north. He will start from the Cape of Good Hope and penetrate to the Zambesi, thence explore the Maruthemambunda territory, the watershed district between the Zambesi and the Congo, visit the lake sources of the Congo, and from there through Darfur he will try to reach Egypt Dr. Holub expects the journey to extend over three years. The expenses, he reckons, will amount to about 50,000 florins, 5000 of which he can himself supply.

Lord Aberdare will preside at the first meeting of the Geographical Society next Monday evening, when Mr Jos. Thomson, the Commander of the East African Expedition, who has lately returned from Zanzibar, will give an account of his journey to the Lukuga outlet of Lake Tanganyika, *viâ* the head of Lake Nyassa. Mr. Thomson's paper promises to be unusually interesting, as the country traversed by him was for the most part previously unexplored.

Another African traveller, Mr. James Stewart, C.E., has just returned to England from Livingstonia, Lake Nyassa Mr. Stewart, it will be remembered, also crossed the unknown belt of country between Lakes Nyassa and Tanganyika by a different route, for the most part, from Mr. Thomson's, and arrived at the south end of the latter lake only a day or two after him

In the November number of their *Chronicle* the London Missionary Society publish a full account of Dr Southon's interview with Mirambo on the subject of the murder of Messrs. Carter and Cadenhead, and the main facts elicited by him appear to exonerate that chief from any direct share in the unfortunate occurrence Mohammed, Capt. Carter's servant, succeeded in saving the journals of both Carter and Cadenhead, and all the most important manuscripts and letters of the former.

The Baptist Missionary Society hope to publish in the December number of their *Herald* an admirable map which they have just received from the Rev. T J. Comber of their Congo Mission, who has been for some time stationed at San Salvador. It is stated to be very carefully drawn to scale, and to exhibit the many and important discoveries made by the missionaries in their various journeys towards Stanley Pool; it will also show the relative positions of the various towns to Banana, Mboma, San Salvador, Makuta, and other important centres

The new *Bulletin* of the Antwerp Geographical Society contains papers by M. Bernardin on the Fiji Islands, their resources, progress, &c., and by Dr. L Delgeur, vice-president of the Society, on cartography among the ancients.

We have received from Danzig an excellent little guide-book to that city, with special reference to the scientific and medicinal points of interest of the town and district, compiled from the recent meeting of the German Association. It is a model of its kind, and contains an admirable series of special maps.

Doctors Rohlfs and Stecker have left Suez for Massowah and Abyssinia.

In the *North American Review* are appearing M Desiré Charnay's notes of his exploring work in Mexico. The November number contains the third instalment.

KEW GARDENS REPORT

From the just-issued "Report on the Progress and Condition of the Royal Gardens at Kew" for 1879 we take the following items:—

Some idea of the magnitude of the destruction caused by the hailstorm of August 3, 1879, may be obtained from the fact that the number of panes broken was 38,649, and the weight of broken glass eighteen tons. The plantations along the Grass Avenue skirting the river have all been greatly improved, very poor specimens removed and replaced by Holm oaks, which will eventually render the avenue practically an evergreen one. This portion of the grounds suffers greatly from the unconsumed smoke of the gas-works and manufactories at Brentford, which is not only most prejudicial to the plants, but so blackens the labels that they become illegible in a few years. Some interesting notes are given on the cultivation of the various kinds of india rubber. According to Hecht, Levis, and Kahn's Report for 1879, Para rubber (*Hevea*) is still the largest source of supply. The total import into England during the year was 4651 tons. Liverpool received 25 tons of Ceará Scrap rubber and 900 tons of African (*Landolphia*), while London imported 350 tons from Assam (*Ficus elastica*), 250 tons from Borneo (*Willughbeia*), and 550 from Mozambique (*Landolphia*). Considerable attention has been paid at Kew during the past year to the examination of the African Landolphias and Malayan rubber-yielding Willughbeias, and the results will be given in the next report Additional facts to those contained in the previous Report are given on the introduction of South American species into the Old World. From Singapore Mr. Murton reports:—"The plants of Hevea and Castilloa in the gardens are now large plants, but hitherto propagation from the strong growths they are making seems rather difficult, whereas they used to propagate freely from the weak wood produced while in pots.' Preparations are being made in Burma for the cultivation of Ceará Scrap (*Manihot glaziovii*), while Dr. King reports that the Ceará rubber promises to grow well in Calcutta; seeds have been distributed to various parts of India, and the plant seems to thrive well in Upper India. Singapore does not seem to suit Ceará Scrap, according to Mr. Murton, while at Zanzibar it yields seed most abundantly, but the seeds are slow to germinate. At Zanzibar the Pará rubber is a less quick grower than the Ceará and does not branch. At Mergui eight Pará trees, the survivors of a batch of seedlings received from Dr. King in 1877, continue to do well in the office compound. At Calcutta, according to Dr. King, Pará rubber continues to be as disappointing as ever; he believes it is useless to try it anywhere except in the south of Burma or the Andamans, and perhaps in Malabar Mr. Jenman reports that the atmospheric conditions in Jamaica appear favourably adapted to the Pará rubber. Equally important information is given as to the cultivation of mahogany in the Old World. On this the Report says. "This may now be regarded as an accepted success. The tree grows well in many parts of India and in Ceylon, and in the former there is a local demand for the wood In this country new uses are found for it, one of the most recent being for the linings and panellings of railway carriages instead of teak, which is now exclusively used for ship building. It is not easy to see any valid arguments against the cultivation of a tree the timber of which is of admitted excellence for a variety of purposes and the growth of which is apparently attended with little difficulty. As late as 1876 the Government of Bengal was adverse to mahogany planting. This policy has now, however, been modified, and in his report for 1878–79 Dr. Brandis, the Inspector-General of Forests, reports: 'Of the exotic trees which are cultivated by way of experiment mahogany is the most important, and its success seems not improbable, though it is too early yet to form final conclusions upon the subject.' Mahogany is also cultivated as an experiment in Burma and the Chittagong district of Bengal. The tree is known to thrive well near Calcutta, and every effort should be made to cultivate it in those forest districts where climate and other circumstances are favourable" Experiments are being made in Queensland, and favourable reports come from Saharunpore and Singapore. Some curious notes are contained in the Report on Chestnut Flour. "We are indebted to Mr. D. E. Colnaghi, H B M 's Consul at Florence, for specimens of the dried chestnuts, flour, and *necci* (the cakes made from them), which are so important an article of subsistence in the Apennines The collection of the specimens for Kew was due to the kindness of Dr. L. Bacci of Castigliano, in the mountains of Pistoja. The fresh chestnuts are dried, or rather roasted, for three days and nights in a *seccatoio*, or drying room, on a latticed floor covering a chamber in which a fire is lighted. The husk is then easily removable, and the kernel is ready to be ground into flour, which is of a pinkish colour. This is mixed to the consistence of cream with water, and poured on fresh chestnut leaves to be baked into small circular cakes, *necci*, between heated stones. The collection having been divided between the museum of the Royal Gardens and the Food Collection, Bethnal Green, Prof. Church, who has charge of the latter, has obligingly furnished us with the following analysis of the flour:—

Moisture	14·0
Oil or fat	2·0
Proteids	8·5
Starch	29·2
Dextrin and soluble starch	22·9
Sugar	17·5
Cellulose, &c.	3·3
Ash	2·6
	100·0

The cakes were found to contain only 6·7 per cent. of proteids, with 3·4 per cent. of flour. The large amount of dextrin is due to the high temperature to which the chestnuts are subjected in the process of drying Prof. Church thinks that chestnut-flour ought to be of easy digestibility, and a suitable children's food, considering that it contains over 40 per cent. of nutritious matters soluble in pure water The Museum of the Royal Gardens is indebted to Mr. George Maw for a specimen of a product used, according to the Rev. Wentworth Webster, who procured it, as tea in the Basses Pyrenées in France, and on the Spanish side of the Pyrenées in Navarre. It was found to consist of the dried shoots of a species of *Lithospermum*, which was identified with probability as *L officinale*." Mr. Noble advocates the cultivation of rye straw (*Secale cereale*) as a paper material, not inferior to esparto. Mr. W L. Booker, H.M.'s Consul at San Francisco, sent some specimens of a scented wood from the highlands of Mexico, known as Lin-a-Loa, and which has been identified with a wood already in the Kew Museum, and which appears to be yielded by a species of *Bursera*. Further material in the shape of dried specimens, with both fruit and flowers, is much to be desired for the purpose of ascertaining definitely the tree which produces it. The name Lin-a-Loa is clearly a corruption of Lign Aloes, which has been identified with *Aquilaria agallocha*, otherwise known as eaglewood (Kew Report, 1878, p. 36). This is however a tree confined to the Old World, and the Mexican one has no connection with it. The wood of the latter is imported into this country for manufacture into perfumery, a fragrant oil known as otto of linaloe being distilled from it. On the interesting Chinese timber-tree known as the Nan-mu-tree, and referred to in the Report for 1877, some information has been obtained from Mr. Baber:—"Two days' journey south-east of Chungking in Szechuen I found several specimens of about a foot in diameter, one of them having a straight branchless trunk of 100 feet in height, with the branches and foliage rising 25 feet above that, another had 70 feet of bare straight stem, and 90 feet of total altitude. Although the trunks are branchless, yet in many cases they send out shoots resembling saplings, which rise parallel with the trunk. The wood is white and close-grained, and I do not believe that the pillars at the Ming tombs near Peking are of this wood. They look more like true teak. I have seen some much larger trees than the above, some two feet and more in diameter, straight and of great altitude. They are used in Szechuen for bridge work." Eventually, through the instrumentality of Père Vincot, who resides at Chungking, flowering specimens were transmitted to the Kew Herbarium From these a figure has been prepared, and they entirely confirm the previous identification of the tree by Prof Oliver (from the leaves alone) as a near ally of *Phœbe pallida* (one of the laurel family). The genus *Phœbe* is now merged in *Persea*, and Prof. Oliver has described the Nan-mu under the name of *Persea nan-mu*, distinguishing it from *Persea* (*Phœbe*) *pallida* "chiefly in stature, in the form of the acumen of the leaves and the character of the indumentum." On a block of Pai-chai wood sent by Mr. W. M. Cooper, H.B M.'s Consul at Ningpo, Mr. R. J. Scott reports:—"The most striking quality I have observed in this wood is its capacity for retaining water and the facility with which it surrenders it. This section, which represents one-tenth of the original piece, weighed 3 lbs. 4½ ozs. At the end of twenty-one days it had lost 1 lb 6¾ ozs. in an unheated chamber. At the end of another fourteen days, in a much elevated temperature, it only lost ½ oz. In its present state of reduced bulk its weight is 1 lb. 10 ozs. It is not at all likely to supersede box; but it may be fit for coarser work than that for which box is necessary." The principal researches conducted in the laboratory during the past year have been those of Mr. Marshall Ward, on the development of the embryo-sac, published in the *Journal* of the Linnean Society, vol. xvii. pp 519–546, Prof. Church, continued investigation on albinism in leaves, published in the *Journal* of the Chemical Society, January, 1880. The laboratory has also been employed for the experimental demonstrations given to the *employés* of the Royal Gardens, and for the examination of the University of London for the degree of Doctor of Science in the subject of physiological botany

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The examinations for the degree of Bachelor of Medicine will commence in the medical department of the Museum as follows:—

The First (Scientific) Examination) November 29.

The Second (Final) Examination, December 6.

Candidates for either of these examinations, and candidates for the certificate in Preventive Medicine and Public Health are requested to send in their names on or before November 15 to the Regius Professor of Medicine at the Museum.

The University of Oxford Commissioners have given notice that all new scholarships and exhibitions granted by the Colleges shall be subject to the provisions of any new statutes which may be made by the Commissioners in relation to the length of tenure and emoluments of such scholarships and exhibitions.

The University Commissioners at present sitting have forwarded to the Hebdomadal Council six proposed statutes which they contemplate making, subject to any representation which they may receive from the Council on the appointment and duties of University Professors and Readers. The proposed statutes include certain general regulations applicable to the whole Professoriate Each Professor must reside six months in each year between October 1 and the ensuing July 1 Each Professor, besides his regular course of lectures, must give one public lecture every year Each Professor must give private instruction to students in matters relevant to the subject of his lectures, and must examine the students who have attended his lectures at the end of each course.

The following are the particular regulations applicable to the Savilian Professor of Astronomy, the Professor of Experimental Philosophy, the Waynflete Professor of Chemistry, the Linacre Professor of Human and Comparative Anatomy, the Waynflete Professor of Physiology, and the Wykeham Professor of Physics. Section 7 relates to the three proposed new professorships.

(1) The Professor shall deliver one course of fourteen lectures at least in each of two out of the three University terms (Easter and Trinity Terms being counted as one), every course shall extend over seven weeks at least, and not fewer than two lectures shall be delivered in each week.

(2) He shall be ready to give the private instruction required by the General Regulations on two days in each week in which he lectures, and during one hour at least on each of such days

(3) The laboratory under the charge of each Professor, and, in the case of the Savilian Professor of Astronomy, the University Observatory, shall be open for eight weeks in each term (Easter and Trinity Terms being counted as one), and at such other times, and for such hours, as the University may by statute determine

Students shall be admitted to the University Observatory and to the laboratory under the charge of each Professor, upon such conditions as the University shall from time to time by statute determine, and upon the terms of paying such fees, not exceeding such amount as may be fixed by any statute of the University in force for the time being, as the Professor may from time to time require.

(4) Except for some grave reason to be approved by the Vice Chancellor, the Professor shall, for seven weeks in each term (Easter and Trinity Terms being counted as one), and during some part of three days in each week, be ready to give instruction in the subjects of his Chair to such students as shall have been admitted to the laboratory under his charge (or, in the case of the Savilian Professor of Astronomy, to the University Observatory); and such instruction shall be given in the laboratory or observatory (as the case may be) or in some class-room connected therewith

(5) The Professor shall also, at the close of each term, inform any college which may request him to do so as to the regularity of attendance and the proficiency of the students belonging to such college who have been admitted into the laboratory or observatory under his charge, and shall give like information, if requested, to the delegates of students not attached to any college or hall.

The Particular Regulations next following shall be applic-

able to the several Professors named in them respectively (that is to say):

(1) The Savilian Professor of Astronomy shall have the charge of the University Observatory, and shall undertake the personal and regular supervision of the same, and of the several demonstrators and other assistants employed therein, and shall be responsible for all the work carried on there.

(2) The Professor of Experimental Philosophy shall have the charge of the Clarendon Laboratory, and shall undertake the personal and regular supervision of the same, and of the several demonstrators and other assistants employed therein, and shall be responsible for all the work carried on there.

(3) The Waynflete Professor of Chemistry shall have the charge of the Chemical Laboratories in the University Museum, or such part thereof as the University may by statute assign to him, and shall undertake the personal and regular supervision of the same, and of the several demonstrators and other assistants employed therein, and shall be responsible for all the work carried on there.

(4) The Linacre Professor of Human and Comparative Anatomy shall have the charge of the Anatomical and Ethnological Collections and the Anatomical Laboratories in the University Museum, or such part thereof as the University may by statute assign to him; and shall undertake the personal and regular supervision of the same, and of the several demonstrators and other assistants employed therein, and shall be responsible for all the work carried on there.

(5) The Professor of Botany and Rural Economy shall have the charge and supervision of the Botanical Gardens and Botanical Collections belonging to the University, and it shall be part of his duty to make such Gardens and Collections accessible to, and available for, the instruction of students attending his lectures

(6) The Professors of Geology and Mineralogy respectively shall have the charge and supervision of the Geological and Palæontological Collections, and of the Mineralogical Collection, belonging to the University, and it shall be part of their duties to make such collections respectively accessible to, and available for the instruction of, students attending their lectures.

(7) { The Professor of Classical Archæology,
The Wykeham Professor of Physics, and
The Waynflete Professor of Physiology,

shall, in like manner, if the University by Statute shall think fit to charge them therewith, undertake the charge of any collections or laboratories connected with the subjects of their respective Chairs, which the University may from time to time assign to them, and shall have similar duties in respect thereof.

(8) The several Professors named in the foregoing particular regulations shall in the performance of the duties committed to them by such regulations be subject to the statutes of the University for the time being in force in that behalf

This Statute is proposed to be made by the University of Oxford Commissioners under the Universities of Oxford and Cambridge Act, 1877, for the University.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, October 26.—M. Wurtz in the chair —The following papers were read .—On attenuation of the virus of chicken-cholera, by M. Pasteur If the most virulent virus (to be got from a fowl which has died of the chronic form of the disease) be taken and successive cultivations made of it in the pure state, in bouillon of fowl's muscles, the interval of time between one sowing and another is found to affect the virulence. With intervals up to one month, six weeks, or two months, no change of virulence is noted, but as the interval is enlarged the virus is found to become weaker. The attenuation does not take place with mathematical regularity. No change can be detected in the microscopic organisms to account for the changes in its power. But M. Pasteur shows by experiments (in which some bouillon, to which a little strong virus had been added, was inclosed and kept some time in sealed tubes) that it is probably the oxygen of the air that attenuates the virulence. May it not then also affect other kinds of virus?—Experimental study of the action of the organism of sheep, more or less refractory to splenic fever, on the infectious agent; what becomes of specific microbia introduced directly into the circulation by large transfusions of anthracoid blood, by M. Chauveau. After such transfusion into animals whose resistance to the disease is considerable and strengthened by preventive inoculation, the bacterian rods soon disappear from the blood (in a few hours one cannot find them). They are not destroyed, however, but are arrested in the capillary system of the lungs and of other parenchymatous organs, where they may be found with retained vitality when the transfusion has been rapidly fatal. When the animal survives more than three days the bacteria disappear from the lung and the spleen (as well as the blood), and health may be regained One region alone proves favourable to maintenance and development of the bacterian life, viz., the surface of the brain (pia mater), and the development there has quite special characters (elongation and inflexion of the rods and appearance of spores), resembling those which belong to artificial cultivations. The infectious activity of these bacteria of the pia mater is considerable.—On linear differential equations, by M. Appell —The Secretary announced the opening of a subscription for erection of a monument to the memory of Spallanzani in his native town.—On the class of linear differential equations, with rational coefficients, the solution of which depends on the quadrature of an algebraic product which contains no other irrationality than the square root of an entire and rational polynome, by M. Dillner.—Photography of the nebula of Orion, by Prof Draper.—Application of selenium to the construction of a photo-electric regulator of heat for the burning in of stained glass windows, by M. Germain. As far as possible from the muffle furnace is placed a dark chamber closed by a parabolic reflector, the focus of which is in the axial line of the telescope commonly used. At this focus is a ball of selenium between two cups of brass, leaving a zone of selenium visible. One cup is connected by German silver wire to a thermo-electric pile (of thirty elements), adapted for strong heat and exposed to that of the muffle, and the pile is connected (by the other poles of its elements) to the side of a stoppered porous vessel filled with water, ensuring a sensibly constant temperature on that side. The thermo-electric current increases with the temperature, and while the part of the muffle covered by the telescope remains dark, the selenium does not effectively alter in resistance, but when a cherry-red tint is reached (indicating time to stop), the resistance of the selenium is reduced about a fourth. The current gains strength and sounds a bell, or affects a system whereby the fuel is diverted (With the pile is connected a galvanometer, a condenser, and other secondary arrangements.) —On some modifications undergone by glass, by M Salleron. He calls attention to the corrosion, deformation, and fracture of areometers used in sugar-works which treat molasses by osmose; where the instruments are kept several days in a liquid at 95°, of density, 1014 (2° B), and containing sugar 115 gr., ash 91 gr ; total 206 gr. per litre. The ash consists of chloride of potassium and organic salts of potash. The cracks are all more or less spiral in form.—Influence of light on germination, by M. Panchon. He measured the quantities of oxygen absorbed during germination by identical lots of seeds. Light (he finds) accelerates the absorption in a constant manner; the advantage in favour of light being from a fourth to a third of the quantity absorbed in darkness. The degree of illumination is relative to the quantity absorbed The respiratory acceleration in seeds illuminated by day persists for several hours in the darkness. The accelerative influence of light is more intense at low temperatures.

CONTENTS

THURSDAY, NOVEMBER 11, 1880

DR. SIEMENS'S NEW CURE FOR SMOKE

THE growing obscurity which distinguishes the winter atmosphere of London has disposed men to consider whether it is an indispensable evil connected with the use of coal in great centres of population, or whether means can be found of providing the warmth and comfort which the copious use of mineral fuel affords us without having to pay the penalty of dispensing with the solar ray, of finding ourselves and everything we touch covered with soot, and of occasionally having, even at midday, to grope our way with a feeling akin to suffocation.

I am decidedly of opinion that the evil is one which not only admits of remedy, but that its cure would result from a closer attention to the principles of economy in the use of fuel

Until within recent years wasteful expenditure was the rule both in the application of fuel to our large manufacturing operations and for domestic purposes, but great strides have been made within the last twenty years to improve our mode of burning fuel both under our steam boilers and in the metallurgical furnace. The Regenerative Gas Furnace, which was the subject of Faraday's last discourse at the Royal Institution in 1862 has contributed its share to this result, combining as it does considerable economy, with the entire absence of smoke from the chimney.

Since by the employment of gaseous fuel results such as these are realised, there seems no *à priori* reason why analogous results should not attend its application on a smaller scale, even down to the means of heating our apartments, which, although a small application in each individual instance, amounts, in the aggregate, to the largest of all the uses of mineral fuel.

Gas-grates have been tried by individuals desiring progress, but I know several instances in which on account of the great comparative expense incurred, and objections raised to the smell, and dry heat, as it is called, in the room, the time-honoured smoky but cheerful coal-fires were reinstated.

A gas-grate that was arranged in my billiard-room in the usual fashion, consisting of three air-gas-pipes with apertures distributed over the fire-grate, and covered with pumice-stone, presented certainly a cheerless appearance, and filled the room (notwithstanding a fair chimney-draught) with fumes, rendering the benefit of the fire a doubtful one. These fumes could not have passed into the room from the upper surface of the pumice-stone owing to its proximity to the chimney, but a little consideration made me come to the conclusion that these gases really proceeded from the ash-pan into the room The products of combustion set up by the gas flames ascend no doubt so long as they are intensely hot, but in giving off their heat to the inert pumice-stone they rapidly cool, and being heavier than atmospheric air, descend through the grate between the lines of gas flames, and thus reach the apartment. Moreover the gas burnt towards the back of the fireplace takes scarcely any part in providing a red radiating surface in front of the grate, serving only to baffle the draught passing towards the chimney from the room

The first condition to be realised in an efficient gas-grate consists in suppressing all gas orifices except immediately behind the bottom front bar, and in substituting for the grate a solid dead plate Instead of using inert matter such as pumice-stone, I consider it far more economical and efficacious to transfer the heat of the gas flames to gas coke or anthracite, which when once heated helps the gas to increase and maintain a sufficient temperature for radiation through its own slow combustion. The gas should not be mixed in the pipe with atmospheric air to produce a Bunsen flame, as is frequently done, because by using the unmixed gas a rich flame is set up between the pieces of coke near the front of the grate, producing to the eye an appearance similar to a well-ignited ordinary coal fire, and the hot carbonaceous matter through which it percolates ensures its entire combustion before reaching the chimney Heat will however gradually accumulate towards the back of the fire, notwithstanding the suppression of the grate bars, and in order to obtain the utmost economy this heat should be utilised to increase the temperature of the gas flames and of the coke in front of the grate

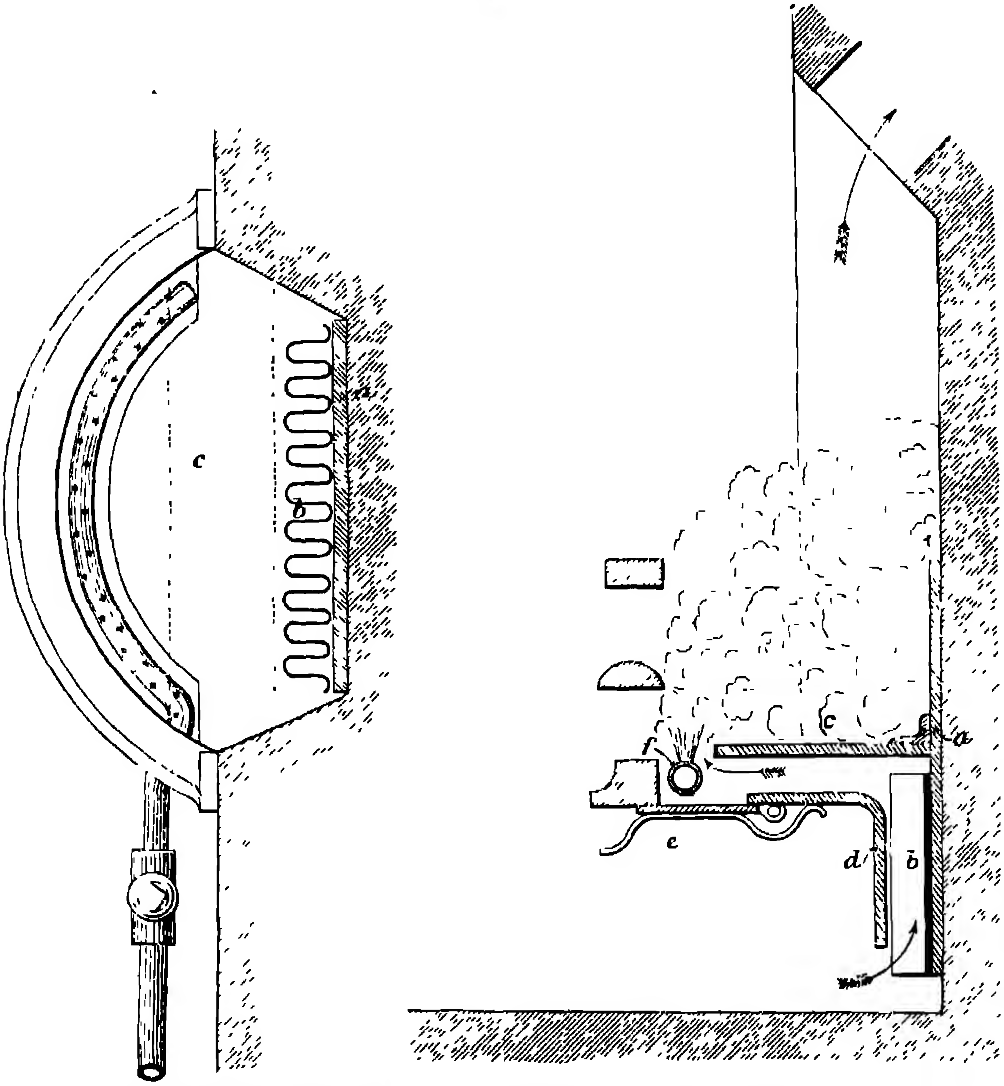
To accomplish this I have constructed a grate according to the annexed sketch. The iron dead plate *c* is riveted to a stout copper plate *a* facing the back of the fire-grate, and extending five inches both upwards and downwards from the point of junction The dead plate *c* stops short about an inch behind the bottom bar of the grate to make room for a half inch gas-pipe *f*, which is perforated with holes of about one-twentieth of an inch in diameter placed zig-zag at distances of three-quarters of an inch along its upper surface. This pipe rests upon a lower plate *d*, which is bent downwards towards the back so as to provide a vertical and horizontal channel of about one inch in breadth between the two plates A trap-door *e*, held up by a spring, is provided for the discharge of ashes falling into this channel. The vertical portion of this channel is occupied by a strip of sheet copper about four inches deep, bent in and out like a lady's frill and riveted to the copper back piece. Copper being an excellent conductor of heat, and this piece presenting (if not less than a quarter of an inch thick) a considerable sectional conductive area, transfers the heat from the back of the grate to the frill-work in the vertical channel An air current is set up by this heat, which, in passing along the horizontal channel, impinges on the line of gas flames and greatly increases their brilliancy So great is the heat imparted to the air by this simple arrangement that a piece of lead of about half a pound in weight introduced through the trap-door into this channel melted in five minutes, proving a temperature to exist exceeding 619° F or 326° C. The abstraction of heat from the back has moreover the advantage of retarding the combustion of the coke there while promoting it at the front of the grate.

The sketch represents a fireplace at my office, in a room of 7,200 cubic feet capacity facing the north. I always found it difficult during cold weather to keep this room at 60° F. with a coal fire, but it has been easily maintained at that temperature since the grate has been altered to the gas-coke grate just described.

This heating arrangement is not however essentially necessary; in several of the grates which I have altered for gas I have simply closed up the space below the bottom bar by means of a close-fitting ash-pan, and introduced the gaspipe behind the lower bar, an alteration which can be effected at very trifling expense, and presents the advantage of great cleanliness, the ash-pan being withdrawn only at intervals of several days for emptying. The appearance of the fire however is in that case much less brilliant than when the hot-air arrangement is added.

In order to test the question of economy I have passed the gas consumed in the grate through a Parkinson's 10-light dry gas-meter supplied to me by the Woolwich, Plumstead, and Charlton Consumer's Gas Company, the coke used is also carefully weighed.

The result of one day's campaign of nine hours is a consumption of 62 cubic feet of gas and 22 lb. of coke (the coke remaining in the grate being in each case put to the debit of the following day) Taking the gas at the average London price of 3*s* 6*d.* per 1000 cubic feet and the coke at 18*s.* a ton, the account stands thus for nine hours:—



a, Copper plate ¼ inch thick and 10 inches wide at back of grate, *b*, grill of copper ⅛ inch thick *c*, iron dead plate rivited to plate *a*, *d*, angle plate with trap-door *e* for removing ashes, *f*, gas-pipe about ½ inch diameter with holes ¾ inch apart

	d.
62 cubic feet of gas at 3*s*. 6*d*. per thousand	2 604
22 lb. coke at 18*s*. a ton . .	2 121
Total .	4 725

or at the rate of 0 524*d*. per hour In its former condition as a coal-grate the consumption exceeded generally two and a half large scuttles a day, weighing 19 lb each, or 47 lb. of coal, which at 23*s* a ton equals 5 7*d*. for nine hours, being 0 633*d* per hour. This result shows that the coke-gas fire, as here described, is not only a warmer but a cheaper fire than its predecessor, with the advantages in its favour that it is thoroughly smokeless, that it can be put off or on at any moment (which in most cases means considerable economy), that it is lit without the trouble of laying the fire, as it is called, and keeps alight without requiring to be stirred

It may appear strange at first that the use of the separated coke and gas to produce a given effect should be fully as cheap as using the raw material combining the two constituents, but the solution may be found in the

circumstance that in the case of the coke-gas fire no heat flashes up the chimney, but is utilised entirely for raising the coke in front of the grate to the condition most favourable to radiation into the room

I hold that it is almost barbarous to use raw coal for any purpose, and that the time will come when all our fuel will be separated into its two constituents before reaching our factories or our domestic hearths. Such a measure would not only furnish us with the complete solution of the smoke question, but would be of great value also as a money saving. In conclusion I may observe that I have taken up this question without the idea of profit, and shall be happy to furnish builders and others desirous to introduce the grate here described with the necessary indications to insure success C. WILLIAM SIEMENS

THE RUSSIAN IMPERIAL YACHT, "LIVADIA"

IN NATURE, vol xxii p. 270, we gave an account of this remarkable ship, and stated that we should report the results of her trials to our readers. We there said "it cannot be doubted that her speed will surpass 14 knots," and we pretty plainly intimated that it would, in our judgment, fall substantially short of 17 knots, in point of fact it has fallen between these limits, and nearer the higher than the lower, the average mean speed at the measured distance being 15 864 knots. The details of the several runs, which have not previously been published in London, we believe, are as follows .—

No. of Run	Indicated H P	Speed in Knots
1	12,267	15 69
2	11,704	15 53
3	12,387	15 83
4	12,437	15 65
5	12,857	15 92
6	12,472	15·65
Average	12,354	15·725

The trials of the *Livadia* were greatly hurried, the vessel going down the river on a Wednesday, making a preliminary run under steam on the following day, Thursday; on Friday she made a run at full speed for six hours, giving an average of 15 knots; and on Saturday she made her measured mile trials. Those who understand the conditions under which these steam trials were made will see at once that it was not possible to obtain the best results with a ship thus put under steam day after day, her boiler tubes getting doubtless more or less foul, and her machinery also falling somewhat out of perfect condition, especially where there were three separate sets of engines to be cared for The bottom was also foul from having been three months in the wet dock at Fairfield. The effect of haste in making the trials is visible in the variations of horse-power developed upon the runs, there being a difference of more than 1000 h p. between the power developed, for example, on the second run as compared with that of the fifth. The speeds given above show less discrepancies than the horse-powers, but it can hardly be doubted that the *Livadia* as she is can be driven at over 16 knots under fair conditions, without any alteration whatever. It is, as has been said elsewhere, highly probable that some improvements might be made in the screw propellers, as it is not to be expected that the best conditions were secured at the first attempt. In fact we have evidence that the central screw was set at a pitch different from that of the side-screws, and runs at a different speed, it now appears likely that the pitch should have been the same in all cases, and when the opportunity offers this change will probably be made, and the speed again taken Other slight modifications will doubtless also be tried, and those of our own naval architects, who have well considered all the facts, have formed the opinion that if all minor causes of interference with the best performance are removed, a speed approaching 17 knots may be reached in the *Livadia*. It needs no words of ours to convince the scientific world that whether any great increase of speed be obtained with this vessel or not, the Russian Government has rendered a vast service to naval science by demonstrating on a large scale and in a public and unquestionable manner, the fact that a vessel whose breadth is enormous, and whose length is but one and a half times her breadth, may with no very inordinate expenditure of power be made to take a high place among the few fastest ships of the world

But the interest in the *Livadia*, while it is greatest as regards her high-speed trials, by no means ends there Her steaming performances with diminished steam power are also very interesting In considering these the reader should remember that in this case as in all cases of fast ships going with reduced power and at reduced speed, the performances are subject to a double disadvantage first the *weight* of the machinery carried is of course in excess of what is needed to produce the reduced power, and secondly, the friction and other losses are likewise in corresponding excess. For example, when the *Livadia* is steaming say at 11 to 12 knots, she is employing less power than any one of her three sets of engines produces, and if she had not to go beyond such a speed she might dispense with the other two sets of engines and boilers, and thus be relieved of nearly 1000 tons of weight, and of two-thirds of the frictional and other losses which she is obliged to undergo when steaming at 11 or 12 knots with all her engines working at a reduced speed Bearing these facts in mind, we may now state that the reduced steaming of the *Livadia* is reported officially to have given the following results —

Aggregate Ind H P	Speed	Wind	Tide
2969	11 knots	With	Slightly
4770	13 ,,	,,	,,
8940	15 ,,	Against	Slightly against
10,037	15½ ,,	,,	Against

The indicated horse-powers above given were calculated from diagrams, and the speed was taken by log The results were reported, we know, in perfect good faith, and are a correct indication, in the main, of the relation between power and speed in the *Livadia* with her present screws, &c. They nevertheless appear to us to exhibit on the face of them some slight discrepancy, which is amply accounted for by the fact that the speeds were, as we have said, taken by the log, which does not admit of that minute accuracy which may and ought to characterise measured mile-trial results The above figures are borne out by the sea-passages of the yacht. She steamed continuously in fair and moderate weather at an average speed of somewhat more than 12 knots with an average expenditure of about 4000 Ind H.P.

With all the above facts and figures before us we see

clearly how vain have been the prejudices, and how baseless the predictions, which condemned ships of this type as incompatible with even moderately good speeds, and as ridiculous when the attainment of high speed was contemplated. It is with no small feelings of vanity, but with a genuine pride in a great scientific triumph which we ventured to predict beforehand, that we have witnessed the *Livadia's* success It is a success which England may well envy, and of which the Russian Government may well be proud Its bearing upon the future of steam navigation cannot fail to be considerable even in the mercantile marine, while it is quite impossible for the war navies of the world to escape its influence Our long-standing objections to the *Inflexible* and *Italia* types of ship are well known to our readers, the construction of such ships under the name of first-class ironclads being most trying even to the common sense, and much more to the scientific sense, of the country. With the *Livadia* in existence, and with the facilities which such great breadth as hers offers to the production of armoured ships worthy of the name, the exposure of our first-class ships to the destructive effects both of shells and of torpedoes, will not be endured We congratulate Admiral Popoff upon the established success of the great idea which he was the first to propound, and as the idea would still have remained a mere idea but for the powerful patronage of the Grand Duke Constantine, we gladly recognise again the scientific acumen and that "courage of his opinions" which distinguish His Imperial Highness By consenting to the trial of so great a naval experiment in a yacht of his own, the Emperor of Russia has secured a sea-palace of great speed, of unexampled accommodation, and of a freedom from rolling and pitching such as no other ship in the world enjoys

On the last-named points—those of pitching and rolling—we have to record very remarkable results We are informed on the best authority that in the gale in the Bay of Biscay, with waves running over twenty feet high, when ordinary vessels were seen rolling and pitching heavily, and even when the gale and the sea were at their highest, the greatest roll to leeward was 5 degrees, and that to windward 4 degrees, while the greatest pitch was 4 degrees and the greatest "'scend" 3 degrees This extreme limitation of motion was most extraordinary, excluding almost all the usual incidents of sea-life Nothing was secured on board, and nothing fell throughout the storm There were occasionally heavy blows of the sea under the flat shallow bow, and these caused much vibration at times, but nothing was disturbed, and even the paint is nowhere cracked throughout the wood-built cabins and palaces of the ship.

In the accident which the *Livadia* met with on her voyage from Brest to Ferrol, by striking heavily downwards upon some floating object or objects during a heavy gale in the Bay of Biscay, with a high and confused sea running, the value of water-tight subdivision has been strikingly demonstrated. The injuries done by the blows were extended by the heavy strokes of the sea under the bluff bow, and several of the forward compartments were filled A scientific friend who inspected the bow after the compartments were pumped out in the harbour of Ferrol, informs us that in two or three places the bulkhead divisions had evidently been badly struck and made leaky at the bottom, and in one compartment the sea was plainly visible through the broken plating. And yet nothing was known on board of these injuries when at sea beyond the fact (ascertained by "sounding") that a forward compartment of the double bottom had been somehow filled, so effectually was the ship proper preserved from all injury within the double bottom, and so little effect had the filling of the forward spaces upon the trim and behaviour of the ship! The *Livadia* is constructed of steel, and is as lightly built as our own fast steel ships of the latest date, and as a similar accident to the recent one might occur again, as it may to any ship of light draught and great buoyancy, it would no doubt be prudent to add something to the strength of the outer bottom where most exposed to strains and blows; but this is a matter of detail which we leave the naval architect to discuss. The great lesson to be derived from the incident is the immeasurable value of double bottoms and of great compartmental subdivision in sea-going structures. An ordinary large steam yacht not so subdivided might have been lost under like circumstances, and certainly would have been more or less jeopordised and more or less injured internally, in the present case not a particle of injury to the interior of the ship or to her costly fittings was sustained, and hours after the accident, with a very high and confused sea still running, the Lord High Admiral of Russia and his guests dined as safely, as easily, and almost as quietly as if he had been ashore in his summer palace of Orianda

A MEDICAL CATALOGUE

Index Catalogue of the Library of the Surgeon-General's Office, U.S. Army Vol i., A—Berlinski 4to, pp. 888 (Washington Government Printing Office)

THE saying of Hippocrates, that art is long and time is short, is so true, not merely of medical art, but of work in general, that most working men find their lives gliding so quickly away that they do not attempt great works, and very probably would not succeed if they did so But every now and then we come across men whose energy is so marvellous, and whose power of getting through work is so enormous, that we are struck with amazement at it Such a man is Dr. Billings, to whose extraordinary energy and perseverance we owe the present work. This purports to be only a catalogue of the Library of the Office of the Surgeon-General of the United States Army, and Dr. Billings takes care to call attention to the fact that it is not a complete medical bibliography, and that any one who relies upon it as such will commit a serious error. "It is," he says, "a catalogue of what is to be found in a single collection; a collection so large, and of such a character, that there are few subjects in medicine with regard to which something may not be found in it, but which is by no means complete." It is not, however, a mere catalogue in the ordinary sense of the word, inasmuch as its contents are not confined to the names and titles of books and their authors. It is also a catalogue of subjects, so that any one wishing to read up a particular subject will find under the appropriate heading a list of the chief works bearing upon it. Nor is this all. There are other catalogues in which a similar arrangement has not only been

attempted but successfully carried out. But this catalogue differs from all others inasmuch as it is the only compilation in which the herculean task of arranging in proper order the contents, not only of books, but of medical periodicals, has ever been essayed. To any person who is aware of the enormous extent of medical periodical literature, and who has had personal experience of the time and labour involved in looking up a few references, it seems almost incredible that any man should have had the courage to venture upon the task which Dr. Billings has successfully accomplished. To give the faintest idea of the work, we take a single heading—Amputation, and we find, besides a large number of works and references under this title itself, several other headings on the treatment of amputation, cases and statistics of amputation, double amputation, history of amputation, intra-uterine amputation, methods of amputation, multiple amputation, sequelæ and after treatment of amputation, spontaneous amputation, amputation in the course of disease, amputation in gunshot wounds, amputation in infants, amputation in joints, amputation in pregnancy, carpal and meta-carpal amputations, tarsal and meta-tarsal amputation, amputations at ankle-joint, amputations of arm, amputations of breast, amputations at elbow-joint, amputations of fingers and toes, amputations of foot, amputations of fore-arm, amputations of hip-joint, amputations of knee-joint, amputations of leg, amputations at shoulder-joint, amputations of thigh, amputations of toes, amputations at wrist-joint, besides cross references to Amputation considered under other heads, such as Gangrene, Hospitals, Surgery, Umbilical Cord, Arteries, Limbs, Osteomyelitis, Spinal Cord, Stumps, Frost-bite, Pregnancy, Pyæmia, Elbow-joint, Breast, Tibia, Ankle-joint, Astragalus, Aneurisms, Arm, Artery, Humerus, &c. On taking a single one of these headings, we find under it nineteen books, and on then attempting to count the references to periodical literature we go along until we come to the end of the letter C, and then stop in despair, for we have already got a hundred references, and find that to proceed to the end of the alphabet will be a work of both time and labour. The wearisomeness of counting the number of references in a small fraction of one sub-head may give the reader some notion of the labour involved in hunting out and writing down the materials, and yet, after all, such idea would be very imperfect, for the labours of Dr. Billings and his assistants have not consisted merely in giving these references. A much greater amount of time and trouble has probably been consumed in the consideration of what should be left out than by the labour of arranging and compiling what should be put in, for in indexing journals and transactions the general rule which they have followed has been that only original articles should be taken, though occasionally important papers in several periodicals, and reprints when the originals have not been in the library, have been indexed. In describing the arrangement of the book we cannot do better than quote Dr. Billings' own words:—

"This catalogue includes both authors and subjects—the names being arranged in dictionary order in a single alphabet. Under the subject-headings are included the titles of original articles in the medical journals and transactions contained in the Library, for which reason the Catalogue is commonly spoken of by those who are familiar with it as the 'Index-Catalogue,' and the name has been adopted as being brief and at the same time distinctive.

"The form adopted is essentially that shown in the 'Specimen Fasciculus' published in 1876, and it has been selected after a careful consideration of the criticisms and suggestions brought out by that fasciculus.

"The great majority of physicians, and especially of American physicians, who have given their opinion, have expressed a decided preference for this form; and although a librarian might find a complete separation of the catalogue of authors from that of subjects a little more convenient, the demand on the part of those who are to use it is very decidedly for the combination here given.

"The following points have been kept in view in the selection and arrangement of the subject-headings:—

"I. Those titles have been selected for subjects for which it is presumed that the majority of educated English-speaking physicians would look in an alphabetical arrangement.

"II. Where there is doubt as between two or more subject-headings, cross-references are given.

"III. Where both an English and a Latin or Greek word are in common use to designate the same subject, the English word is preferred, and references are given from the others.

"IV. As a rule, substantives rather than adjectives are selected for subject-headings. Exceptions occur to this in anatomical nomenclature, as 'Lachrymal duct', 'Thyroid gland'.

"V. In names of subjects derived from personal names, the latter precede, as 'Addison's disease', 'Eustachian tube'.

"VI. Local diseases or injuries are as a rule placed under the name of the organ or locality affected, as 'Kidney (*Abscess of*)'; 'Neck (*Wound of*)'. There are exceptions to this, in accordance with Rule I, *e.g.*, 'Abscess (*Perinephritic*).'

"VII. Cases in which one disease is complicated with or immediately followed by another are placed under the name of the first disease with the sub-heading '*Complications and Sequelæ*.'

"VIII. When the main subject of an article is the action of a given remedy in general, or its action in several diseases, it is indexed under the name of the remedy; but if it relate to its action in but one disease, it is indexed under the name of the disease.

"IX. The amount of sub-division made under the principal subject-heads depends very greatly upon the number of references to be classed.

"X. As a rule, the references are given from general to more special heads, but not the reverse. It is presumed, for instance, that those who wish to consult the literature on 'Aphasia' will turn to 'Brain (*Diseases of*)' and 'Nervous System (*Diseases of*),' as well as to 'Aphasia,' without being directed to do so by a cross-reference under the latter title.

"XI. Under the name of an organ will be found the books and papers relating to the anatomy and physiology of that organ. Following this usually come the abnormities and malformations of the organ, then its diseases, then its tumours, and lastly, its wounds and injuries.

"Anonymous works or papers are entered in regular order under the first word of the title not an article or preposition. Russian and Japanese titles are transliterated, and a translation is usually appended. Greek *names* are transliterated for the sake of uniformity in type.

"In indexing journals and transactions, the general rule has been that only original articles should be taken, but occasionally important papers are indexed in several periodicals, and sometimes a reprint is indexed when the original is not in the Library.

"The List of Abbreviations of Titles of Periodicals prefixed to this volume shows the journals and transactions which have been indexed to the present time. The right-hand column exhibits the volumes or numbers possessed by the Library, and, negatively, the deficiencies, which it is my earnest desire to fill. The List of Abbreviations is separately paged in order that it may be bound by itself, if desired, for use with succeeding volumes.

"Some of the abbreviations of names of places, especially in the United States, might have been still further shortened if the Catalogue had been intended for use only in this country But an analysis, by subjects, of so large a collection of medical periodicals is, necessarily, useful in St Petersburg, for example, as well as in Washington, its measure of utility in any locality being the extent of the collection of medical periodical literature therein. Intelligibility to foreigners, therefore, has been regarded as a quality essential to the abbreviations in question.

"In indicating pagination, the rule is that where the article does not exceed two pages in extent the first page only is given If it exceed two pages, both the first and last pages are noted.

"The work of preparing this Catalogue began in 1873, and has been carried on persistently, and as rapidly as the amount of clerical aid available and the nature of the work would permit.

"The present volume includes 9090 author-titles, representing 8031 volumes and 6398 pamphlets It also includes 9000 subject titles of separate books and pamphlets, and 34,604 titles of articles in periodicals"

The rapid progress of every branch of science, medical and otherwise, and the proportionate, or perhaps we ought almost to say disproportionate, increase of medical and scientific periodical literature, render it exceedingly difficult for the student to keep himself *au courant* with the newest discoveries The Royal Society's Catalogue of scientific papers conferred an inestimable boon upon scientific men, but it left much to be desired, inasmuch as it gave only the names of authors, and contained no index of subjects. Sometimes, too, its strict confinement to periodical literature is felt as an imperfection, for in cases where discoveries have been published in the form of pamphlets of a few pages, one searches through the Catalogue in the vain expectation of finding them However, we have hitherto had nothing at all resembling it in medical literature, but now we possess the first volume of a work which greatly excels it both in scope and size. Such defects as the volume possesses are due to the imperfections of the library of which it is a catalogue, and it is to be hoped that all those (and their name must be legion) who profit by the use of this remarkable production, will do their best to enable Dr Billings to make good the deficiencies.

It is clear that, however complete any catalogue may be at the time of its publication, the constant appearance of new books and pamphlets day by day and month by month must render it more and more defective. In order to supplement this catalogue, and prevent this gradually increasing deficiency from being felt as an evil, Dr. Billings and Dr. Fletcher are now publishing the *Index Medicus*, a monthly classified record of the current medical literature of the world. This is published by F. Leypoldt in New York, and by Trubner and Co in London. The great labour and expense involved in getting out this monthly index require for it a large circulation. At present, we believe, it is published at a loss, and an increased number of subscribers is urgently requested in order to permit its continuance. We therefore trust that every one who finds his time and labour saved by this Index-Catalogue will show his gratitude to Dr. Billings and those who have assisted him, not only by helping to supply the wants of the library at Washington, but by subscribing regularly to the *Index Medicus*.

We cannot conclude this brief notice without congratulating the United States Government on having in its service such men as Dr. Billings and his able assistants, Doctors Fletcher, Yarrow, and Chadwick, nor without expressing the thankfulness which every medical man owes to them for the great boon they have conferred on medicine in printing and issuing the present Index-Catalogue

THE PHILOSOPHY OF LANGUAGE

Max Muller and the Philosophy of Language By Ludwig Noiré (London Longmans, Green, and Co. 1879)

THE substance of this work has already appeared in the German periodical *Nord und Sud*, and the author here tells us that he has reproduced it in an enlarged form and in an English dress in order to do full justice to Max Muller's great merits in clearing the way "for future investigators" He considers that eminent services have been rendered to the cause of linguistic studies by the writings of the illustrious Oxford professor, and four out of the five chapters comprising this treatise are mainly occupied in putting this somewhat obvious fact in the clearest light. But he holds, in common probably with Max Muller himself, that the problem of the ultimate origin of articulate speech has not been solved in the brilliant and deservedly popular "Lectures on the Science of Language" Many difficulties are there removed, much light is thrown upon a great number of obscure points, several abstruse questions are treated with an amazing wealth of illustration, bringing them home to the meanest capacity, and sundry popular views, notably those stigmatised as the "Pooh-pooh" and "Bow-wow" theories, are either exploded, or reduced to their proper value. But the mystery of origin, the inexplicable ultimate residuum of roots, forming the constituent elements of all speech, remains almost unassailed, though distinct service has undoubtedly been done by narrowing down the question to this one issue. A still greater service is done when the gifted writer emphatically declares that these roots "are not, as is commonly maintained, merely scientific abstractions, but they were used originally as real words." This gave the death-blow to the Platonic "types," ideas, metaphysical entities and concepts which had still continued to obscure the subject, and block the way like so much mediæval rubbish. Herr Noiré aptly compares them to the *ova*, whence all animal and vegetable life. "By their development and uninterrupted growth all the known languages of the world have reached their marvellous structure, and become the body of reason and the instrument of mind" (p 55).

In the last chapter, which will doubtless be read with the greatest curiosity, the author takes up the subject where Max Muller had left it, and develops the theory on

the origin of language, which he had already broached in his "Ursprung der Sprache," specially devoted to that question. The essential peculiarity of the view here advocated is contained in the following passage —"Language is the CHILD OF WILL, of an active, not of a passive state; the roots of words contain the *proper activity of men*, and receive their significance from the *effects* of this activity in so far as it is phenomenal, *i e* visible. Human thought arises from a double root, the subjective activity, or the will, and the objective phenomenon which is accessible to the senses."

Language is further represented as "a product of *association* and of the community of feeling which is developed, intensified, and finally carried to perfection by community of life" (p. 81). Great stress is laid on the fact that human thought has a double root, the subject or individual activity, and its effect in the action, whence it follows that "the life of language stands in an indissoluble relation to the development of human action" (p. 83) The earliest meanings of verbal roots are all said to be "referred to human action," such notions as to dig, strike, scrape, scratch, tear, lying at the root of endless derived and secondary concepts.

Human thought is conceived as "an active process, a self-conscious, self-confident activity, not as a crude materialism imagines, the accidental play of unconscious atoms" (p 88) This active process is traced to common action, and language itself becomes "the voice of the community" (p 88). The essence of language consists in the naming of things, while the power of forming a notion of a thing, that is, of a group of phenomena grasped and conceived as one, constitutes the essential difference between man and the brute creation At the same time man can conceive of things only "because he has the gift of speech, because he can give them a name" (p. 90).

The power of giving names flowed from the power of using signs. "He used signs and thereby attained to the power of using names also; or, in other words, of betokening again by a sound what he had noted before" The transition from one process to the other, attributed to the active will, is stated to be "the most important part of the theory" (p. 92).

Then the power of giving signs to things grows out of the habit of modifying them for his own use. "Men dug caves, plaited twigs, stripped the beasts of their skin, the trees of their bark. Hence was developed the marvellous hitherto unexplained gift of abstraction, and this in the most natural way. Man learnt to conceive a thing as he learnt to create things. His own creations were the first *things* for him" (p 92). So that language conceives objects only "in so far as human action has touched, modified, reconstructed them; in a word, in so far as they have received *form*." Even such things as exist independently of the human will, or lie beyond the sphere of human action, are nevertheless brought within the sphere of human speech. "They become objects of human thought in the same way as the rest, that is to say, they are named as they would be, if the human hand had formed them" (p 98).

Such is the line of argument pursued in the attempt to build up a new theory of articulate speech, which is here conceived by an evident disciple of Schopenhauer and the Monistic school, as an emanation of the self-conscious human will, flowing from the power of forming abstract ideas, and dealing primarily and exclusively with such things only as are either the direct creation, or brought under the direct control and modifying influence of man. But this seems to be a complete perversion of the natural sequence of events in the evolution of man and all his faculties. Of these the very highest, next at all events to the moral sense, consequently the latest to be developed, was the conscious will. In the lowest savage tribes it is still often so feeble as scarcely to be distinguished from mere sensation and animal impulse Yet the speech even of the rudest tribes is almost invariably found to be of a very intricate mechanism, subject to definite laws of structure and harmony, possessed at times of a copious vocabulary, embracing a variety of objects entirely beyond the influence or control of man himself, objects whose names cannot by the most violent straining be traced to those of things created or modified by human action. It is very easy to quote a few instances in support of such a theory as this, especially from such highly imaginative languages as those of the Aryan family, in which analogy and metaphor have had such free play during a long period of comparative culture But hundreds of such examples would bring us no nearer than we were before to the starting point, to the faculty of naming things and actions, to the reason of certain sounds being selected in preference to others wherewith to name them.

The question still remains unanswered, whence came the "limited store of sounds with which man accompanied his action," and which are said to have in some mysterious way "associated themselves with the objects produced or modified by the action" The difficulty does not lie in the derivation of *cælum* or *hole* from a primitive root *sku* or *ku*, but in tracing the origin of this root itself, and, in general, of all roots, whether they have to do with human action or not. For it is not for a moment to be supposed that all the roots even of the Aryan family can be identified with the names of things subject to human influence. Such are, for instance, *as* expressive of mere existence, hence passive rather than active, *idh*, *indh*, to burn, whence αἴθω, αἰθήρ, *æstus*, *heat*, &c , words all applicable primarily rather to the powers of nature than of man, *ud*, *und*, to flow, whence ὕδος, *udum*, *unda*, Goth *wato*, *water*, &c , a purely natural object named directly from a purely natural conception, *svan*, to resound, whence *sonus*, *sound*, *svanitam*, *sonitus*, all words expressive of natural noise, and if Eichhoff is right in connecting the Gothic *sangws* and English *song* with this root, then these human actions can be conceived only as secondary derivatives from the primary idea of natural sound. This is the logical order of sequence, but it is as subversive of the author's theory as are many other Aryan roots which need not here be quoted. Enough has been said to show that this theory, while leaving the real question of origin untouched, will apply in any case to a part only of the original stock of roots in the Aryan family Nor, as stated, will it help us in the least towards an explanation even of these

On the whole it is to be feared that our author leaves the matter much where Max Muller left it at the end of his "Science of Language", for the theory here advocated assuredly does not answer the questions · How do mere cries become phonetic types? How can sensations be changed into concepts? These questions can be answered

only by divesting the mind of all metaphysical vagaries, and approaching the discussion in a spirit of strict loyalty to the established principles of evolution. The universe is not "a mental phenomenon," as Schopenhauer would call it, nor is speech the deliberate product of conscious will. It is an organism which, like all other organisms, had its origin in a germ, and its slow growth and silent development in suitable surroundings, independently of all conscious action. Yet in dealing with a subject of this sort one still feels how much easier it is to refute error than to establish truth. "*Utinam tam facile vera invenire possim quam falsa convincere*" A. H KEANE

OUR BOOK SHELF

Easy Lessons in Science. Edited by Prof. F. W Barrett I. *Easy Lessons in Heat* By C A. Martineau II *Easy Lessons in Light.* By Mrs. W. Awdry (London · Macmillan and Co, 1880.)

THESE excellent little lesson books deserve a wide circulation. Well and clearly written, they are at the same time strictly of the "scientific" rather than of the so-called "popular" style of exposition; there being none of the objectionable sensational element with which certain French works in light science have too greatly familiarised us The cuts with which the volumes before us are illustrated are numerous, appropriate, and many of them original In each case the reader is instructed in the simple apparatus needed to repeat the experiments described; so that a teacher who desires to give to young pupils a few elementary lessons in the sciences of heat and light will find here the very text-books most suited to his requirements. Miss C. A. Martineau's "Lessons in Heat" follows the usual order of text-books in that science. The first lesson deals with expansions, the second with notions of temperature, the third tells "how heat spreads," and so forth, and in the concluding chapters some of the fundamental facts of the relation between heat and mechanical work are made known One experiment which we do not remember meeting with before in the shape in which it is given deserves to be cited. It is a variation on Davy's old experiment with flame and gauze "Put a bit of camphor *on* the wire gauze, and hold a light *under* it. The vapour of the camphor passes freely through the gauze, catches fire, and burns with a blue flame till the whole of the camphor has been turned into vapour and burned But the flame does not pass through the gauze to set fire to the solid camphor"

Mrs. Awdry's "Lessons on Light" are no less felicitous in their treatment of the subject The usual popular text-book on Optics abounds in descriptions of different optical instruments, telescopes, microscopes, kaleidoscopes, and the like, without much trouble being expended upon first principles. But in these lessons first principles claim the prominent place: the first point explained is the law of inverse squares, and the second the geometrical laws of refraction and reflection—and the explanations are admirably yet quite simply done. A most interesting feature is that the latter half of these easy lessons is devoted to physical optics. One chapter on the wave-theory, and two entitled "Measurings" prepare the way for a capital lesson on Diffraction A lesson on the Spectrum and one on the Rainbow close the series.

We do not say that there is no room for criticism in judging these little volumes A professed teacher of Natural Philosophy might grumble at the omission of certain things that claim prominence in all the older text-books and in many of the syllabuses of contemporary examinations Yet we would challenge such critics to produce a more useful, or suggestive, or accurate set of lessons, or one more entirely free from the two besetting faults of sensational popularisation and educational cram.

It is to be hoped that Prof. Barrett will continue his labours in adding to the series he has so ably edited.

Outline of a Course of Natural Philosophy, with Specimen Examination Papers. By Gerald Molloy, D.D (London. Simpkin, Marshall, and Co, 1880.)

THIS work of 114 pages contains a syllabus-outline of the course of lectures in Natural Philosophy by Dr. Molloy, at the Catholic University of Ireland, and is reprinted chiefly to meet the wants of teachers in intermediate schools. To the syllabus, which is remarkably full and complete, is appended an extensive series of examination papers on all branches of physics except light, electricity, and magnetism, which are promised to follow These questions, though chiefly elementary, have been carefully prepared, and are a valuable part of the work. In an appendix Dr. Molloy reprints a paper giving an account of his particular form of bichromate battery, which appears to be peculiarly suited to the needs of schools and colleges, where a powerful battery of convenient form is required to be in readiness for occasional use

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications*]

[*The Editor urgently requests correspondents to keep their letters as short as possible The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Sir Wyville Thomson and Natural Selection

I AM sorry to find that Sir Wyville Thomson does not understand the principle of natural selection, as explained by Mr Wallace and myself. If he had done so, he could not have written the following sentence in the Introduction to the Voyage of the *Challenger* —"The character of the abyssal fauna refuses to give the least support to the theory which refers the evolution of species to extreme variation guided only by natural selection." This is a standard of criticism not uncommonly reached by theologians and metaphysicians, when they write on scientific subjects, but is something new as coming from a naturalist. Prof. Huxley demurs to it in the last number of NATURE, but he does not touch on the expression of *extreme variation*, nor on that of evolution being guided *only* by natural selection. Can Sir Wyville Thomson name any one who has said that the evolution of species depends only on natural selection? As far as concerns myself, I believe that no one has brought forward so many observations on the effects of the use and disuse of parts, as I have done in my "Variation of Animals and Plants under Domestication", and these observations were made for this special object. I have likewise there adduced a considerable body of facts, showing the direct action of external conditions on organisms; though no doubt since my books were published much has been learnt on this head If Sir Wyville Thomson were to visit the yard of a breeder, and saw all his cattle or sheep almost absolutely true, that is, closely similar, he would exclaim: "Sir, I see here no extreme variation; nor can I find any support to the belief that you have followed the principle of selection in the breeding of your animals." From what I formerly saw of breeders, I have no doubt that the man thus rebuked would have smiled and said not a word If he had afterwards told the story to other breeders, I greatly fear that they would have used emphatic but irreverent language about naturalists. CHARLES DARWIN

Down, Beckenham, Kent, November 5

Geological Changes of Level

In a most friendly notice in your last issue of the *Memoirs* forming the first volume of the official Report of the *Challenger* Expedition, Prof. Huxley takes exception to a sentence in my short Introduction. "There seems to be sufficient evidence that all changes of level since the close of the Palæozoic period are in direct relation to the present coast lines," and he asks in what possible sense this can be the case.

I fully admit the criticism, and that the sentence as it stands does not explain itself.

That it is not a relation of ordinary parallelism Lyell's and D'Orbigny's maps of old coast lines, a map published by myself in "The Depths of the Sea," and particularly the beautiful later maps of Jurassic, Cretaceous, and Tertiary France by M. Delesse, abundantly show. I have explained my idea of the relation in position between the recent deposits and those of the Tertiary and Secondary periods in "The Depths of the Sea" (pp 472-476) at some length I believe that the Jurassic, the Cretaceous, and the Tertiary formations are essentially *marginal* deposits, and that their belts of deposition form approximately a series of contour bands upon an elevation which has persisted throughout a long series of local and general oscillations, the sum of which has raised the whole through a small vertical range. Such oscillations have also, doubtless, affected the bottom of the sea, but nowhere to such an extent as to modify in any important degree the conditions of the abyssal region

Prof Huxley says, "There is nothing, so far as I am aware, in the biological or geological evidence at present accessible, to render untenable the hypothesis that an area of the mid-Atlantic or of the Pacific sea-bed as big as Europe should have been upheaved as high as Mont Blanc and have subsided again any time since the Palæozoic epoch, if there were any grounds for entertaining it." I think however he will admit that the following *Challenger* data, if they can be established, afford at least a presumption against an oscillation of such a kind, at all events in post-Triassic times, beyond which it is difficult to stretch even the imagination

The careful researches of my colleagues, Mr Murray and the Abbé Renard, with which I have had the advantage of being familiar during their progress, have led us to the belief that (1) the chalk of the Cretaceous period was not laid down in what we now consider deep water, and that its fauna, consisting mainly of shallow-water forms, merely touches the upper limit of the abyssal fauna, and (2) that no beds exist in the series of known sedimentary rocks which correspond in composition and in structure with the beds now in process of formation in the abyssal sea ("The Atlantic," vol. ii. p 299).

The hypothesis of the elevation of a mass of land equal to Europe and as high as Mont Blanc in the middle of one of the great ocean basins could in our present state of knowledge be defensible only on the supposition that it was a phenomenon of the same order as the elevation of some portion of our existing continental land, and there is now, to say the least, grave reason for doubting that any rock which is due to accumulations formed at depths over 2500 fathoms, the average depth of the basins to which Prof. Huxley refers, enters into the composition of any existing continent. The present land consists of a set of crystalline rock-axes of various ages, with a long succession of sedimentary deposits, all of which give evidence of having been laid down in water of moderate depth, piled up upon and against them. Such a hypothesis therefore, besides being without a single fact in its support, would be met by a strong adverse argument from analogy, and would be, so far, in a worse case than the hypothesis of the origin of species by natural selection.

I thoroughly agree, however, with my friend Prof. Huxley that "the value of the great work which is now being brought before the public does not lie in the speculations which may be based upon it, but in the mass and the solidity of the permanent additions which it makes to our knowledge of natural facts," and I imagine that all of us who are engaged in that work look upon it as our first and paramount duty to present these natural facts which have been acquired as simply and as effectively as we can. Still the generalisations or impressions, or whatever they may be, of the few men selected to observe these facts are as much a part of the result of the Expedition as anything else, and I think it is also our duty to offer them to our fellow-workers for what they are worth. C. Wyville Thomson

Bonsyde, Linlithgow, November 6

"The First Volume of the Publications of the 'Challenger'"—A Correction

There is a typographical error in my notice of the *Challenger* publications, published in last week's Nature, for which I should, of course, be disposed to blame the printer, had it not been hinted to me that my handwriting is sometimes not so clear as might be wished

I appear (p 2) to agree with the proposition that "the deep-sea fauna presents us with many forms which are the *dried* and but little modified descendants of Tertiary and Mesozoic species."

As few things can be much wetter than the inhabitants of the ocean abysses, this opinion seems to be, to say the least, eccentric.

But "dried" should have been printed "direct," which was the word denoted by my graphic symbols T. H. Huxley

4, Marlborough Place, Abbey Road, N W, November 7

Correspondence of Phenomena in Magnetic Storms

The Astronomer-Royal having lately received from the Observatory of Zi-ka-wei, in China (latitude 31° 12′ north, longitude, from Greenwich, 8h. 6m east), lithographed copies of the photographic traces of the declination and horizontal force magnets, extending from August 11 to 14, and from August 17 to 20 of the present year, has placed them in my hands for comparison with the Greenwich records Some particulars of this comparison are herewith annexed. Greenwich time is used throughout.

A general examination of the two sets of curves shows that the disturbances were usually greater in magnitude at Greenwich than at Zi ka wei. Comparing the curves in detail, it is found that on August 11, at 10 20[1] a m, after a quiet period, the declination and horizontal force magnets at Greenwich both made a sudden start, which was the commencement of a magnetic disturbance, lasting until midnight An apparently equally sudden start (from a quiescent state), in both declination and horizontal force, is shown on the Zi-ka wei curves, occurring in declination at 10 12 a m, and in horizontal force at 10.20 a.m. (as nearly as the small scale on which the curves are drawn will allow measures to be made) This first motion was to decrease the west declination and increase the horizontal force at both places A bold motion in the two Zi-ka-wei curves at 11 30 a m. (increase of declination, decrease of horizontal force) has corresponding decrease of horizontal force at Greenwich, not accompanied, however, by much motion in declination. And of numerous fluctuations occurring at Greenwich between noon and midnight of the same day, some appear to correspond with motions at Zi ka wei, whilst others do not.

A calm state follows at both places, until near noon of August 12. On this day at about 11 40 a m the magnets at Greenwich made a further start, and until 4 p.m the movements were large. A corresponding start is also shown in both the Zi ka wei curves (commencing, according to the register, some minutes sooner than at Greenwich), the movements following being similarly large. Afterwards, until 6 a m. of August 13, considerable oscillation was nearly continually shown at Greenwich, there being especially a large change of declination between 7 and 9 p.m (August 12), but there is no strongly marked motion at the latter time at Zi-ka-wei, and the changes are throughout much smaller than at Greenwich Later on August 13 further oscillations occur at both places, but the separate motions are in no particular accordance. The period of disturbance seems definitely to come to an end at both places at 6 a.m on August 14.

A period of quiet is broken at Greenwich on August 18, at 1 45 p.m, by a sharp though small movement both in declination and horizontal force (increase of both). There is a corresponding sharp increase (after quietude) of horizontal force at Zi ka-wei, but no change of declination. A bold increase of declination and decrease of horizontal force at Greenwich at 7 a m. of August 19 is accompanied by a similar decrease of horizontal force at Zi-ka wei, but with little change of declination. Bolder changes occur at the latter place at noon, but with comparatively small change at Greenwich. The magnets become quiet at both places at or near midnight of August 19.

The general result of this comparison of Greenwich and Zi-ka-wei curves appears to be that, after a quiet period, the first indication of disturbance, if sudden (it need not be large) occurs simultaneously or nearly so at both places, but that during the

[1] Approximately stated to be 10 30 in my previous letter (Nature, vol xxii p 361) and so quoted by Mr. Whipple (p 558). The time above given is more exact

continuance of disturbance the oscillations of the magnets seem to be so locally modified that it becomes difficult to trace correspondence: some movements appear to correspond, and some not. A strongly-marked bend in the trace at one place may appear, as it were, stunted in that at the other place, or may not be perceptible at all The disturbances appear to die out at pretty much the same time at both places. All this confirms very much what Mr. Whipple has already pointed out as regards Melbourne (NATURE, vol. xxii. p. 558).

M. Dechevrens, in some remarks which accompany the sheet of curves, notes that the disturbance of August 11-14 is the greatest experienced since the establishment of photographic registration at Zi-ka-wei in the year 1877, and he considers that the changes then observed (those of vertical force included, of which he gives no curves) are similar to such as would be produced by a powerful magnet placed in a certain defined position It may perhaps be here pointed out that the results given by the Astronomer Royal in his paper, "First Analysis of One Hundred and Seventy-seven Magnetic Storms" (*Phil. Trans.* for 1863) appear to give no support to a theory of this kind, and indeed seem conclusively to show that at Greenwich the observed disturbances cannot be accounted for in any such way.

It should be added that M. Dechevrens reports also that strong earth currents were experienced on August 11 and 12 on the submarine telegraph lines connecting Shanghai with Nagasaki and with Hong Kong, as well as on the land lines in Japan, so much so that correspondence was frequently interrupted, but that no interruption appears to have been experienced on the occasion of the generally smaller magnetic disturbance of August 18 WILLIAM ELLIS

Royal Observatory, Greenwich, November 6

Meteor

A VERY large and brilliant meteor was observed here at 6h 41m. p.m G M.T., on November 8 Its size was at least equal to one fourth of that of the full moon, and it lit up the whole garden for about a second and a half. It was pear-shaped. The colour was white, and left behind it a pale red train. Its path was from a point half-way between α and δ Persei to 3° above ν Ursæ Majoris. The sky was rather hazy at the time.

Stonyhurst Observatory, November 9 S. J PERRY

Condition of Jupiter

ON the evening of the 2nd I had a fine view of Jupiter with my 6-inch Cook's equatorial The general appearance of the planet was remarkable for the bright colouring of the belts and of the red spot, a circumstance strongly noted by a gentleman who was observing with me, and who had not seen the planet for some time

I could not however trace the usual white ring round the red spot. Below the red equatorial belt was a row of four or five small irregularly-shaped spots, nearly black in tint, and resembling sun-spots, seen under a low power.

These dark spots seem now affecting Jupiter's surface in several parts, and are certainly not usual to it About 9h. 26m. Satellite I. was occulted. I watched it gradually coming to contact, and at last it seemed to advance on the face of the planet, at least one-half of its diameter appearing to project thereon. It then faded out gradually

September 3, 1879, at 9h 8m, with the same instrument Satellite III. reappearing after occultation, was slightly (but certainly) projected on to the disk of the planet It will be interesting to notice whether the present condition of Jupiter will be accompanied by more than ordinary displays of auroræ, of which symptoms have already appeared.

Guildown, November 6 J. RAND CAPRON

P.S —Since writing the above accounts reach me of auroræ at Brighton on the 3rd and in the Orkneys on the 4th instant.

Vox Angelica

MANY of your readers may be acquainted with the nature of the Vox Angelica stop on a good organ. It consists of two ranks of pipes of small scale and delicate quality of tone, one of which is tuned slightly sharp, so that a wavy (hence called *Unda Maris*) sound is produced. Now it is possible to obtain very similar effects on an ordinary Estey American organ. Given the viola and violetta stops to be drawn out, wrap a band of india-rubber (an ordinary elastic band does very well) round the neck of the viola stop so that it cannot return completely home, on moderate pressure, and allowing a fraction of an inch to intervene between its true final position when inactive; beats will be heard of intensity depending upon the deviation from complete occlusion of this stop. The nearer the viola stop is to occlusion the more rapid the beats, but it is undesirable to obtain rapidity, as the lower notes are too prominently out of tune in this case. Anybody can, by experiment, determine the proper amount of deviation to be employed, and having done this the effect is remarkably good. On an Estey, the two stops mentioned are the only admissible ones for such an experiment, from consideration of overtones. No doubt some of your readers may adopt a more elaborate and convenient method of regulating the deviation than by elastic bands, after some experiments. It may seem a paradox to obtain beautiful concordant effects by the use of discordant vibrational relations, but it is undeniable that on a first class organ the Voix Celeste, or Vox Angelica, or Unda Maris, is a most beautiful stop, and is capable of producing perfect *con sordini* effects. GEORGE RAYLEIGH VICARS

Woodville House, Rugby, November 3

Solids and Liquids at High Temperatures

SOME years ago I made an investigation much simpler but somewhat similar to that referred to by Prof Carnelley in NATURE, vol. xxii p 435 An account of the experiments then made was communicated to the Royal Scottish Society of Arts, 1874-75. One of the results of that investigation was that while we do know something about the temperatures at which different forms of matter change from one state to another when a "*free surface*" is present, yet we are utterly ignorant of the temperature at which that change will take place when no "*free surface*" is present. It will be necessary here to explain that a "*free surface*" is any surface of the body under examination at which it is *free* to change its state. A surface of water, for instance, in contact with its own vapour is a "*free surface*" for the water passing into the gaseous state. The surface of a piece of ice in water, again, is a "*free surface*" at which the water may freeze or the ice may melt. And what are known as the freezing, melting, and boiling points of water are the temperatures at which these changes take place when such "*free surfaces*" are present. As to what the freezing, melting, and boiling points are when these "*free surfaces*" are absent, we have at present no knowledge whatever. All we know is that the freezing point is lower, and the "melting" and "boiling points" are higher, than when "*free surfaces*" are present.

The first of these points is too well known to be referred to here. The last point was illustrated in the paper referred to by an experiment in which water was heated in a metal vessel under atmospheric pressure to a temperature far above the "boiling point," when the water exploded and violently ejected itself from the vessel The superheating of the water was accomplished by carefully excluding all "*free surfaces*" by bringing the water into as perfect contact with the metal of the vessel as possible

Many experiments were also made to get direct and thermometric experimental illustration of the existence of ice at a temperature above the "melting point," but no satisfactory illustrations were got, on account of the great difficulty of getting quit of "*free surfaces*" Of course so long as there existed a "*free surface*" at the surface of contact of the ice with the thermometer, the temperature at that part could not rise above the "melting point." It was however shown by indirect evidence that ice may exist at a temperature above the "freezing point" by referring to the well-known and beautiful experiment of passing a beam of light through a block of ice. When this is done with the aid of proper apparatus it is seen that the heat of the ray is absorbed by the ice, and that melting takes place at different points inside the block. Now the presumption is that the heat is absorbed at all points inside the block, but as the melting only takes place at certain points the heat absorbed where there is no melting must raise the temperature of the ice at those points above the "melting point," and the heat there absorbed by the ice will be conducted to the "*free surfaces*," where it is spent in melting the ice

Now though I was perfectly prepared to find that Prof. Carnelley had succeeded in heating the *inside* of a block of ice to a temperature above the "melting-point," I certainly did not expect so high a temperature as his experiments indicate to be

possible. But what is still more puzzling is how Prof. Carnelley succeeded in burning his fingers with the ice. Our previous knowledge would lead us to suppose that the outside surface of the block of ice was a *free surface*, and that therefore it would be impossible, however high the temperature of the inside of the block, to heat the outside above the "melting point," as we should expect the ice to melt or to sublime at the outside, and keep the temperature at 0° C.

These expectations being disappointed, we naturally look to the decreased pressure under which Prof Carnelley's experiments were made for an explanation of this most unexpected state of matters Now it is very evident that when dealing with pressures of about one atmosphere, and with temperatures of 120° and 180° C, that pressure, as pressure, has nothing whatever directly to do with the "melting point" of the ice While this is the case, it is equally evident that it has a most important influence on the surroundings of the ice. At the pressure of 4 6 mm., at which the experiments were made, no water would be present, there would be nothing but ice and water-vapour. Here then appears to be the great teaching of Prof Carnelley's experiments *They show that the surface of ice bounded by its own vapour is not a "free surface"* This result is so very unexpected that much consideration will be necessary before we can re arrange our ideas to meet the new facts

We might imagine that nothing could be more free than the surface of a body bounded by nothing but its own vapour, yet Prof Carnelley's experiments seem to say it really is not so, and not being a "*free surface*," we of course know nothing whatever of how high the temperature will require to be before the ice will melt under these conditions

These experiments of Prof. Carnelley's are so interesting that we wait with impatience a full description of them His results indicate something new with regard to the influence of a liquid on its melting solid I observe that Prof. Carnelley's results are doubted by most of your correspondents, but for the present we must accept them when Prof Carnelley distinctly states that the temperature of the ice was taken by means of a thermometer in contact with the ice JOHN AITKEN

Darroch, Falkirk, N B., October 30

Wire Torsion

IN the letter in NATURE, vol xxii p 604, which we wrote at the request of Major Herschel, who asked for information regarding the connection between tensional and torsional strains of a brass wire, we mentioned that there were many papers scattered through the *Proceedings* of learned societies dealing with the fluidity of metals There is one communication to which we might specially have referred, as it deals in particular with the torsional yielding of wires under tension, and this is a paper on "Torsion," by Prof G Wiedemann, in the *Annalen der Physik und Chemie*, No 4, vol vi, 1879, pp 485-520, and of which a translation is given in the *Philosophical Magazine*, vol. ix, January 1880, pp 1-15, and February, pp 97-109 The first part of this paper gives a detailed account of experiments which show:—(1) That a brass wire often subjected to a particular torsion, either in one or in both directions, becomes "killed" for any less torsions, that is, follows Hooke's law for its temporary torsions, (2) that a wire under tension acquires greater torsional set from a given torsional couple than when the wire is unextended, (3) that a wire under even considerable tension may be killed by torsion in alternately opposite directions, that is, it will obey Hooke's law for any tension or torsion less than the stresses actually applied originally. Prof Wiedemann in the second part of his paper considers the well-known "agitation effects," and enters on an explanation of the phenomenon based upon molecular allineations referring to the magnetisation theory of Weber and Kohlrausch which is based on the same idea

The strains in Prof Wiedemann's wires were however much less than in those used in Major Herschel's experiments.

JOHN PERRY
W E. AYRTON

London, November 8

Heat of Formation of a Compound

IN NATURE, vol. xxii p. 608, there is a paper on "Recent Chemical Research," in which under the head of work by Thomsen the following law is enunciated:—

"The heat of formation of a compound substance is the difference between the sum of the heats of combustion of the constituent elements of the compound and the heat of combustion of the compound itself." After that it is shown that this is not the true heat of formation of the compound, as many important corrections have to be made On referring to Berthelot's "Essai de Mécanique Chimique" I find the following:—"The heat of formation of an organic compound from its elements is the difference between the sum of the heats of total combustion of its elements and the heat of combustion of the compound with formation of identical products"

Can any of your readers inform me whether Thomsen or Berthelot first enunciated this law?

Another point is, that Berthelot apparently makes no reference to the corrections for the heat absorbed in dissociating the molecules of the elements, &c A P. LAURIE

Edinburgh, November 1

The Yang-tse, the Yellow River, and the Pei-ho

IN replying to the letter of your correspondent (NATURE, vol. xxii p 559) on the subject of my recent paper on these three rivers, I have to thank him for his very probable explanation of the excessive estimate made by Sir George Staunton of the amount of sediment discharged by the Yellow River.

The estimate given in my paper of the water discharge of the River Plate is *ipso facto* an assumption made by Mr. George Higgin from Mr. Bateman's calculation of the minimum flow of that river, which he found to be 670,000 cubic feet per second. It might have been better, however, if I had added Mr Higgin's qualifying remark that such an estimate of the mean volume of water was "very much under the mark" (NATURE, vol xix. p. 555)

The anomaly of the surface current varying in velocity with the same average depth of water has not been unnoticed by myself, though I am unable to give a satisfactory explanation of the difficulty H. B. GUPPY

Woodlane, Falmouth, November 6

The Thresher

WHAT is the "thresher"? It is generally assumed to be the fox-shark (*Alopias vulpes*), but in a recent number of *Land and Water*—which I have only just seen—Mr Frank Buckland says that he believes it to be "the gladiator dolphin or sword grampus" (*Orca gladiator*). This he infers from a drawing of Lord A Campbell's, of which he gives a copy. The tail, he says, is not that of the fox shark But as it is heterocercal it cannot be that of a grampus or any other Cetacean Whatever it is I suppose that there is no doubt that it throws itself out of the water ("high as the masthead" [of a trawler] one of Mr. Buckland's correspondents avers) Does it do so more than once? Once, many years ago, between Sydney and New Zealand, I saw, what they said was a fight between a thresher and a whale, but there was nothing to be seen beyond a splashing of the water Last year off Lisbon I witnessed a similar event Does the sword fish also attack the whale? Lord A. Campbell, in the letter accompanying his drawing, estimated the length of his thresher at "upwards of thirty feet," this is twice the length given by Yarrell FRANCIS P PASCOE

October 30

Since the above was written I see that Dr Gunther, in his new work on Fishes, says: "Statements that it (the fox shark) has been seen to attack whales and other large cetaceans rest upon erroneous observations' (p 322)

"STUDENT" should refer to Newcomb's "Popular Astronomy" with respect to the larger telescopes. For results he must refer to the publications of the Royal and Astronomical Societies, the Washington Observatory, &c.

PAUL LAFARGUE.—We regret we have no further details on the labours of the U S. Fish Commission in increasing the food supply of the country

ILLUSTRATIONS OF NEW OR RARE ANIMALS IN THE ZOOLOGICAL SOCIETY'S LIVING COLLECTION

I

THE sagacious founders of the Zoological Society of London made it a special rule that no dividends or gifts of any kind should be distributed amongst the

members. On the contrary, every Fellow has to contribute an annual sum towards the maintenance of the Society's establishment, unless he prefers to pay a life-composition in lieu thereof. Moreover, the Society are so fortunate

FIG 1 —The Musk deer (*Moschus moschiferus*) (From a drawing by Mr J Wolf from nature)

as to be unencumbered by borrowed capital They have consequently no burden in the shape of interest to be provided for It follows that after putting aside

FIG 2 —The Japanese Wolf (*Canis hodophylax*).

from their income a sum sufficient to meet the annual expenditure, they are able to devote the surplus to new buildings in the Gardens, and to the acquisition of new and rare subjects for the menagerie. While the supply of lions, tigers, elephants, and other well-known animals must always be kept up for the delectation of the ordinary public, and for the maintenance of the best possible living series of animals, it is also thus in their power to acquire animals of specially scientific value, in which the casual observer would take little interest, and which would, therefore, be quite ineligible except in a scientific point of view This course of action has been adopted for many years, more especially since the foundation of the office of "Prosector" to the Society. For these special acquisitions not only delight the eyes of the intellectual observer while they live, but furnish the prosector with subjects for his studies when dead. Those who are acquainted with the *Proceedings* and *Transactions* of the Zoological Society of London will be well aware of the amount of work that has thus been accomplished as regards the anatomy of many of the rarer birds and mammals.

It is, however, by no means by purchase only that rare animals are added to the Zoological Society's collection. Numerous friends and correspondents in almost every corner of the earth are in constant communication with the Secretary of the Society, and are ever endeavouring to obtain specimens that may be acceptable to the collection. In fact the donations have of late years become so numerous that they have not unfrequently rivalled in number and interest the objects acquired by purchase Taking the acquisitions from these two sources together, there are always a considerable number of objects in the Society's collection that specially invite the attention of the observant naturalist. Amongst these rarities there are at the present moment the following, of which illustrations are given, drawn upon wood by Mr J Smit, an artist constantly employed by the Zoological Society.

1. The musk-deer (*Moschus moschiferus*) was well known to the older writers on zoology as the animal that has from long periods of time supplied the "musk" of commerce This scent is still much in vogue in the East, but in Western Europe has been long superseded by more refined perfumes, though it may be remarked that one of the fashionable dealers in Bond Street still keeps a stuffed musk-deer in his window, and is doubtless ready to supply the product in question.

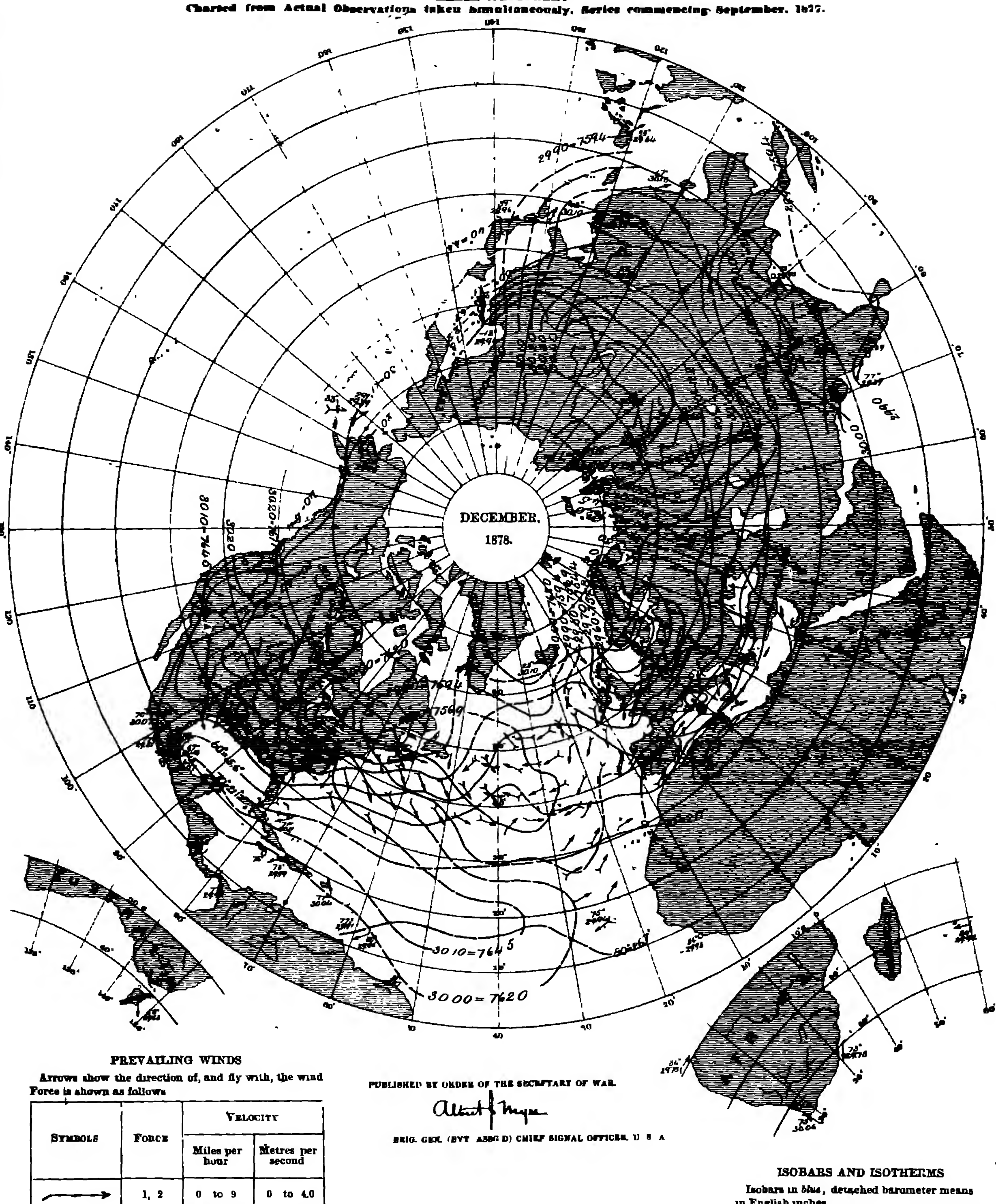
The musk-deer was until recently usually associated with another group of mammals to which it has really very little affinity Dr Gray and other systematists united it with the Chevrotains (*Tragulus*) of India and tropical Africa —a group of ruminants remarkable for their small size and hornless heads, and presenting somewhat of the appearance of diminutive antelopes. M. Alphonse Milne-Edwards of Paris was, we believe, the first naturalist to show that this allocation was unnatural. In his excellent essay on the Chevrotains, published in 1864, M. Milne-Edwards proved conclusively that these little-understood animals constitute a peculiar family of ungulates quite distinct from either the Bovidæ or Cervidæ, and in fact in some respects approaching more nearly to the pigs (Suidæ). The correctness of these observations has been since fully demonstrated by Prof. Flower, Mr. Garrod, and other systematists.

The musk-deer therefore remains unique in its own group, and constitutes a special division of the Cervidæ

Office of the Chief Signal Officer,

UNITED STATES ARMY

Charted from Actual Observations taken simultaneously. Series commencing September, 1877.



PREVAILING WINDS

Arrows show the direction of, and fly with, the wind
Force is shown as follows

SYMBOLS	FORCE	VELOCITY	
		Miles per hour	Metres per second
⟶	1, 2	0 to 9	0 to 4.0
⟶	3, 4	9.1 to 22.5	4.1 to 10.1
⟶	5, 6	22.6 to 40.5	10.1 to 18.1
⟶	7, 8	40.6 to 67.5	18.1 to 30.2
⟶	9, 10	67.6 up	30.2 & over

PUBLISHED BY ORDER OF THE SECRETARY OF WAR.

Albert J. Myer

BRIG. GEN. (BVT. ASSG D) CHIEF SIGNAL OFFICER, U. S. A.

ISOBARS AND ISOTHERMS

Isobars in *blue*, detached barometer means in English inches

Isotherms in *red*, detached temperature means in degrees Fahrenheit

Broken lines, are doubtful

INTERNATIONAL MONTHLY CHART

Showing mean pressure, mean temperature, mean force and prevailing direction of winds at 7 35 A. M., Washington mean time, for the month of December, 1878, based on the daily charts of the International Bulletin

but long may we wait, it is to be hoped, before this event shall happen.

Of the curious nesting habits of *Scopus* we have excellent accounts from Brehm, Heuglin, and other naturalists who have visited the Upper Nile. But one of our own countrymen, a not less active or experienced observer—has likewise written a most interesting account of this bird's economy, and we cannot do better than transcribe a part of it

"The *Hammerkop* (literally hammerhead)," says Mr Layard in "The Birds of South Africa," "is found throughout the Colony and all the way to the Zambezi, frequenting ponds, marshes, rivers, and lakes. It is a strange, weird bird, flitting about with great activity in the dusk of the evening, and preying upon frogs, small fishes, &c At times, when two or three are feeding in the same small pool, they will execute a singular dance, skipping round one another, opening and closing their wings, and performing strange antics.

"They breed on trees and on rocky ledges, forming a huge structure of sticks, some of them of considerable thickness. These nests are so solid that they will bear the weight of a large, heavy man on the domed roof without collapsing The entrance is a small hole, generally placed in the most inaccessible side. The eggs, three to five in number, are of a pure white, axis 1" 9"', diam 1" 4"'

"On my late friend Jackson's farm, at Nel's Poort, there is a singular rocky glen between two hills In this spot a beautiful permanent spring called 'Jackalsfontein' takes its rise Of course, in consequence, there are a few wild almond and other trees, and the place is a little oasis amid the barren mountains. It is a favourite resort of wild animals, hyænas, leopards, jackals, &c., and here Mr. Jackson has constructed one of his most successful hyæna-traps On the ledges of the rocks in this secluded spot a colony of Hammerkops have built for years. Some of the nests are quite inaccessible, while others can be reached with a little trouble I counted six or eight within fifty yards, and some of them contained at least a large cartload of sticks Mr Jackson told me they occupied the same nest year after year, and added to it or repaired it as required. About some that I visited I found brass and bone buttons, bits of crockery, bleached bones, &c. Mr. Jackson said if a 'Tottie' lost his knife or tinder-box on the farm, or within some miles of the place, he made a point of examining the hammerkops' nests, and frequently with success, the birds, like the 'Bowerbird' of Australia, embellishing their dwellings with any glittering or bright coloured thing they can pick up."

A SUCCESSFUL AFRICAN EXPEDITION

AFRICA is overrun with explorers of all nationalities Too often of late have we had to read of failures, of abortive attempts on the part of expensively-equipped expeditions to reach the field of their work, or of deaths by fever or assassination after the first difficulties were overcome. In spite of all, however, the unprecedented activity of recent years in this favourite field of exploration has pretty well filled up, with the leading features at least, that great blank space in the heart of the continent which in the rude maps of our schoolboy days was marked "unexplored." In the very centre of that space there is still however a blank, giving ample scope for work for the numerous Belgian expeditions that have hitherto done so little. It was to fill up this blank to some extent that the Geographical Society, about two years ago, obtained subscriptions to send out an expedition under young Keith Johnston, who had inherited an enthusiasm for geographical work quite worthy of the name he bore As his subordinate and as geologist to the expedition, the Society appointed another young Scotchman, Mr Joseph Thomson, a pupil of Prof. Geikie, who recommended him to the Geographical Society. To him, we grieve to say, it has been left to tell the story of the expedition, which he did, and did well, on Monday night at the opening meeting of the Geographical Society. This expedition is remarkable in many respects, in some points more remarkable than any other African expedition that we know of The outline of its story is soon told. With 150 of the best men that could be found in and around Zanzibar Keith Johnston left that place in May, 1879, and striking at once to the south-west, made for the north end of Lake Nyassa, which was the real starting-point for fresh work. Little more than a month after the start, young Johnston, who seemed to have the nerve and stamina of an athlete, succumbed to the malarious influences of the coast region, and was buried by his companion at Behobeho, to the north of the Lufiji river. Mr. Thomson, inexperienced youth of twenty-two though he was, was equal to the emergency With admirable tact and nerve he took his place as the sole leader of the expedition, and accomplished even more than the work which the Society had chalked out for it. By an unexplored route, through barren wastes and over lofty mountains, through the sneaking Wakhutu and the warlike Mahenge, he and his followers made their way till their eyes were gladdened and their weary spirits refreshed by the sight of the waters of Nyassa Thence, after brief rest, they resumed their march over the lofty and undulating plateau, which they found occupied the region between the north end of Nyassa and the south shore of Tanganyika Leaving here the bulk of his followers, Mr Thomson, with a handful of men, trudged his way over the rugged western shores of Lake Tanganyika, to visit the Lukuga and settle the question whether it was an outlet or an affluent of the lake, a question, which, one would think, could be easily solved, but on which Stanley and Cameron published diametrically opposite statements After visiting the missionary station near the mouth of the river, and running across to Ujiji, Mr Thomson returned to the Lukuga and traced it for some miles of its downward course. After barely escaping from the murderous Warua with their lives, the party sailed down the lake, and rejoining their companions made the return journey to Zanzibar along the usual caravan route with unprecedented rapidity, in about a year after the expedition set out under their late chief Mr. Thomson declared with just pride that all this was accomplished without the shedding of a drop of blood for either offensive or defensive purposes, with one exception he brought all his men back "in the best of health and condition"; he has collected certain information about a considerable region which no white man had previously visited, he has solved one of the few remaining great problems of African geography; and he has located with certainty a great salt lake (Hikwa) whose existence previously had only been based on native rumour Mr. Thomson is a trained geologist, and as such he has doubtless seen more than almost any previous explorer. He tells us of the metamorphic schists and gneiss which compose the mountains of the great central plateau; of the many extinct volcanic cones that lie around the north-west end of Lake Nyassa, and of the metamorphic clay slates, felspathic rocks and volcanic porphyries and tuffs that look down on the lake from the north and north-east. His further geological insight may dispel some of the illusions that seem to be abroad as to the abounding wealth of the African Interior. Much of the country between the coast and Nyassa is barren waste; and the chief characteristic of the region between Nyassa and Tanganyika he found to be "utter barrenness and the absence of anything worth trading for" Instead of the mountains of iron and the miles of surface coal, nowhere did he see a single metal in a form which a white man would for a moment look at as a profitable or workable speculation; there is very little more iron, he

maintains, than is sufficient to supply the simple wants of the natives. Coal he saw none, and he does not believe that such a thing exists over the wide area embraced in his route. This may be discouraging, but it is wholesome, and may prove a check to the wild schemes sometimes broached by speculators for opening up the African interior. From the Chimboya Mountains to the southeast of Tanganyika Mr. Thomson found numerous streamlets flowing southwards, doubtless to join the Chambeze, which, after passing through many a lake and levying tribute from a region one million square miles in extent, pours its almost Amazonian volume, as the Congo, 3000 miles below, into the bosom of the broad Atlantic The much-debated Lukuga he found, as Mr Hore had found shortly before him, to be a broad and rapid river, flowing westwards from the Tanganyika Lake to the Lualaba, as the Congo here is called; and Lake Hikwa he saw was a fine sheet of water with no outlet, lying among the lofty mountains, which stretch away east from Southern Tanganyika What may be the extent and value of the purely geographical observations obtained by Mr Thomson we have no means of knowing, doubtless in this respect the expedition suffered in the death of Mr Johnston, who was a trained geographer But in other respects, in information as to the structure of the country, the nature of its products, and the character of its varied peoples, the expedition under Mr. Thomson has been fruitful to a high degree, altogether it is one of the best pieces of original work which our not too energetic Geographical Society has ever done. Mr. Thomson's well-written and well-read paper was received with enthusiasm by an unusually distinguished audience We trust to be able very shortly to give details concerning both the geography and geology of the Central Plateau from Mr Thomson's own hands

UNITED STATES WEATHER MAPS, DECEMBER, 1878

IMPORTANT changes took place this month in the distribution of the earth's atmosphere as compared with what obtained during the previous month, and these were accompanied with at least equally important changes in the geographical distribution of the temperature.

If a line be drawn from Texas to Newfoundland across the Atlantic, the north of France and Germany, thence curving round to south-eastward through the Black Sea, the Caucasus, India, the East India Islands, and Australia to the south island of New Zealand, it is found to pass through a broad and extended region where atmospheric pressure was throughout considerably below the average of December, and this low pressure was still further deepened at various points along the line. Again, another line passing from Australia through the Philippine Islands, Japan, Mantchooria, Behring's Straits, and Alaska, also marks out an extensive region where pressure was uninterruptedly below the mean

On the other hand atmospheric pressure was above the average, and generally largely so, over the United States to west of long. 90°, over Greenland, Iceland, Faro, Shetland, and over a large portion of the Old Continent bounded by a line drawn from Lapland round by Lake Balkhash, Canton, Pekin, to at least the upper waters of the Lena. Another area of high pressure extended from Syria, through Egypt and East Africa to the Cape, and part of a third area of high pressure appeared in the north island of New Zealand

As regards North America, the greatest excess of pressure, 0·196 inch above the average, occurred in the Columbia Valley, from which it gradually fell on, proceeding eastward to a defect from the average of 0·146 inch about Lake Champlain and to northward, rising again to near the average on the north of Nova Scotia. To the north-east and north of this region exceedingly high pressures for these regions and the season prevailed, being 0·635 inch above the average in the north-west of Iceland, 0·500 inch in the south of Greenland, and at the three stations in West Greenland, proceeding northwards, 0 445, 0 402, and 0 346 inch

West Greenland being thus on the west side of the region of high pressure which occupied the northern part of the Atlantic, and on the north-east side of the area of low pressure in the States and Canada, strong southerly winds set in over the country, and the temperature rose at the four Greenland stations proceeding from south to north to 1° 1, 8° 8, 12° 1, and 14° 4, above the averages As the centre of lowest pressure was in the valley of the St. Lawrence about Montreal, strong northerly and westerly winds predominated to southward and westward, and there consequently the temperature was below the average, the deficiency at Chicago and St Louis being 9° 5; and winds being easterly and northerly in California, temperature there was also under the average. On the other hand, in the New England States, the greater part of the Dominion of Canada, a considerable portion of British America, and in West Greenland, as already stated, temperature was above the average Pressure was much higher at St Michael's, Alaska, than it was to south-westward at St. Paul's, Behring Straits, and in connection therewith and with the prevailing winds, the temperature at St Paul's was 2°·9 below the average, whereas at St Michael's, where strong southerly winds prevailed, the temperature rose to 12° 0 about the normal. Hence whilst the continent of America presented striking contrasts in the distribution of pressure in December, 1878, it presented still more striking contrasts in the distribution of the temperature. Along Baffin's Bay the excess of the temperature above the normal was 14° 4, and at Behring Straits 12°·0, but in the south of Lake Michigan it was 9°·4 below it In this last case the change of temperature from November to December was probably unprecedented, the mean for November having been 13° 7 above the average (NATURE, vol. xxii. p. 516), whilst the December temperature was 9° 5 below it, the difference being 23° 2!

Turning now to Europe, it is seen that Iceland lay on the east side of the patch of high pressure which overspread that region, northerly winds consequently prevailed, and with them a lowering of the temperature to 7°·2 below the average. The contrast this offers to West Greenland is very instructive. In both localities pressure was unusually high, but they occupied different positions, the one on the east and the other on the west of the same area of high pressure, with the inevitable result, of opposite prevailing winds, accompanied in the one case with a temperature 14° 4 above the average, and in the other 7°·2 below it. Hence as regards the temperature at the surface of the earth, it is not the height of the barometer which rules, but the situation of the locality with respect to areas of high and low pressure, or to put it more popularly, it is the winds which are chiefly concerned in the distribution of the temperature

In Europe the area of lowest pressure occupied the southern shores of the North Sea, extending thence, though in a less pronounced form, to south-eastward Hence over the whole of Western Europe winds were north-easterly, northerly, and in the south-west of Europe westerly, thus everywhere, from the North Cape to the north of Italy, temperature was below the normal, in some cases very greatly so, the deficiency being 10° 4 in the south of Norway, and 12° 2 in the south of Scotland. This is the lowest monthly mean temperature known to have been recorded in Scotland since thermometric observations began to be made

On the other hand, to the east of this area of low pressure, winds were southerly, and consequently temperatures were high. In some localities in Russia an excess of about 15°·0 occurred, and even over a large proportion

of European Russia the excess rose to 9°.0. This region of high temperature extended eastward into Siberia, as far as the Irtish, or to where the centre of the greatest excess of pressure prevailed. To the eastward of this area of highest pressure winds were northerly, and low temperature prevailed over the whole of the eastern part of Asia, the deficiency at Nertchinsk, on the Upper Amoor, being 6°.8 below the normal. Here, again, just as happened in America, places having the atmospheric pressure equally high above their average presented the strongest contrasts of temperature. Thus at Nertchinsk pressure was 0.154 inch, and at Bogoslovsk 0.211 inch above their respective averages; but at Bogoslovsk, on the west side of the anticyclonic patch of high pressure, temperature was 15°.0 above, whereas at Nertchinsk on the east side it was 6°.8 below the average.

This time of the year being the summer of the southern hemisphere, pressure falls to the annual minimum in Australia, but during December, 1878, this annual low pressure was still further diminished. Pressure at this season also falls to the annual minimum in the North Pacific and North Atlantic, and we have seen that the low pressure of these regions was likewise still further diminished. But in the case of the Atlantic it was accompanied with a vitally important difference. The centre of lowest pressure of the North Atlantic in winter, which is commonly located about Iceland, was removed many hundreds of miles to southward, and an unwonted development of extraordinarily high pressure appeared to northward, overspreading the extensive region of, at least, Baffin's Bay, Greenland, Iceland, Faro, and Shetland.

It was to this region of high pressure that the extreme severity of our British weather at the time was due. This high-pressure region was intimately connected with, and in all likelihood occasioned directly by the atmospheric movements resulting from the enormous extent of low pressure to southward, with its large centres of still lower pressures in the United States, mid-Atlantic, and the North Sea, where pressures were respectively 0.146 inch, 0.322 inch, and 0.307 inch below the normals. If future inquiry establish such a direct connection between the areas of low and high pressure, it is evident that when we come to attempt, on scientific grounds, to forecast the weather of the coming season for the British Islands, we must look to the Atlantic for the data on which the forecast is to be based.

In the winter months pressure rises to the annual maximum over Central Asia, and in America about the region of the Rocky Mountains. In December 1878, however, pressure rose in both regions greatly above its usually very high average, the excess being nearly a quarter of an inch in the valleys of the Yenisei, Obi, Irtish, and Tobal, about lat. 60°, and 0.200 in America in the Columbia Valley. It follows therefore that with the singular outstanding exception of the high-pressure area of Greenland, the meteorological peculiarities which make December, 1878, so memorable, arose out of a distribution of the earth's atmosphere, essentially the same that commonly obtains at this time of the year, but the usual irregularities in the distribution of the pressure appeared in more pronounced characters.

We have now had the pleasure, through the courtesy of the late General Myer, of presenting our readers with a series of Twelve of these unique Weather Maps, which open out a new future to meteorology. The map for December, 1878, closes the series which appears in NATURE. The questions which a perusal of these maps raises are of first importance, whether we consider the atmospheric changes they disclose, these being repeatedly so vast as to stretch across four continents at one time, besides being often profoundly interesting from their influence both on the food supplies and the commercial intercourse of nations; or the large problems hereby presented, with hints toward their solution, which underlie physical geography, climatology, and other branches of atmospheric physics. We have thus had shown us from month to month, in a way not hitherto possible, the great atmospheric changes as influenced by oceans and continents, including the important parts played in bringing about these changes, by mountain ranges, extensive plateaux, and physically well defined river basins. Much yet, however, remains to be done, principally by extending the network of observation in order that the Weather Maps may show, in an approximately adequate manner, the meteorology also of the North Pacific and the southern hemisphere. Till this be done many fundamental questions cannot be discussed, such as the inter-relations of the different continents and oceans of the globe in their bearings on successive meteorological changes; and the important inquiry as to whether the pressure of the earth's atmosphere be practically a constant from month to month, and, if not, what are the conditions or forces on which the observed differences depend. For the bringing of this great international work to so happy a consummation, we look with confidence to the War Department of the United States, since this implies no more than a continuance of the same energy and enlightened liberality that have won for the Americans their high position in meteorology.

SEARLES VALENTINE WOOD

PALÆONTOLOGY has sustained a severe loss in the death of the veteran explorer of the English Pliocene deposits. Born towards the close of the last century, the late Mr. Wood was from an early age an ardent collector and student of the fossils so abundantly found in the crag-pits of East Anglia. At this period the facilities for collecting the fossils of the English Pliocene strata were much greater than at present. Fresh pits for the purpose of obtaining the shelly marls and sands, which were then extensively used for manure, were continually being opened in the counties of Norfolk and Suffolk, while at the present time the new chemical manures have caused the crag to be quite neglected by agriculturists. The geologist who visits the Eastern Counties at the present day to study the Pliocene has to content himself with such exposures as he can find in old pits, now often overgrown with vegetation and which are used as sheep-folds or stackyards.

Mr. Searles Wood, as he himself said, was born within sight of one crag-pit, he resided for a great part of his life in the crag country, and hoped to be buried within sight of a crag-pit.

In the year 1839 Mr. Searles Wood joined the Geological Society of London. The following year was marked by the establishment of the London Clay Club by seven earnest students of fossils, of whom we believe only Prof. John Morris, formerly of University College, London, still survives. The object which the members of the London-Clay Club set before themselves was the figuring and describing of the British Tertiary fossils.

The London-Clay Club was the forerunner of, and became merged in, the Palæontographical Society of London. This Society has published between thirty and forty volumes, which have appeared annually, and has accomplished a most valuable work in the illustration of our British fossils.

At a very early date Mr. Searles Wood and his friend the late Mr. Frederick Edwards agreed to divide between them the work of describing the mollusca of the English Tertiary formations. The absence of marine Miocene formations in this country divides our British Tertiaries into two great groups, the Older Tertiaries, in which the great majority of the mollusca belong to extinct species

and the Newer Tertiaries, or crags, in which a large proportion of the forms belong to species still living in the seas of some portion of the globe. Mr. Searles Wood naturally chose the latter group for his study, and Mr Edwards the former.

Upon the great task he had set before himself Mr. Searles Wood appears to have entered with characteristic energy, and in 1847 the Palæontographical Society was able to issue its first volume, which was entirely from the pen of Mr. Wood, and consisted of a description of the Crag Univalves, illustrated by twenty-one plates. In the years 1850, 1853, and 1855 Mr Searles Wood was able to publish the parts of his descriptions of the Crag Bivalves, illustrated by thirty-one plates

It soon became evident however that Mr. Edwards had taken upon his shoulders a lion's share of the work, and his friend Mr. Wood, having completed his own task, had to come to the aid of his fellow-student of the Tertiary fauna. It was then agreed that Edwards should complete his description of the Older Tertiary Univalves and that Wood should take up the description of the Bivalves Between the years 1859 and 1877 Mr Searles Wood published his descriptions of the Eocene Bivalves, illustrated by twenty-seven plates

Additional discoveries of fossils having afforded Mr. Wood fresh materials, a supplement to the "Crag Mollusca" was published by him between the years 1871 and 1873. This work was illustrated by twelve plates, and included a very valuable memoir on the strata from which the fossils were obtained, written by his son, Mr Searles V. Wood, jun , and Mr. Harmer of Norwich, who have both done so much good work in unravelling the complicated problems connected with the geology of East Anglia

Nor did the zeal of Mr. Wood allow him to rest even here; for in 1877, in spite of his advanced age, we find him commencing a supplement to his own and Edwards's work on the Eocene mollusca

In the year 1860 the Geological Society recognised the great services rendered to science by Mr. Searles Wood by presenting him with the blue-riband of geology, the Wollaston Medal Prof Phillips, who, as president of the year, handed the medal to Mr. Searles Wood, spoke in terms of well-merited praise of the important works which were the result of his patient, persevering, and successful labours.

Mr. Searles Wood and his friend Mr Edwards were remarkable examples of a type of scientific man which, happily for us, is far more common in this country than in any other. They were both engaged in the legal profession, but found time in their leisure hours to accomplish most excellent and useful scientific work. In the volumes of the Palæontographical Society the work of amateurs like Searles Wood, Edwards, and Davidson appears side by side with that of Richard Owen, Edward Forbes, and John Phillips. The subscriptions of the members cover the cost of engraving and printing, but all other charges are defrayed by the authors, who expect and receive no kind of payment for their important labours.

The valuable collection of Tertiary fossils made by Edwards and Searles Wood have fortunately been secured by the authorities of the British Museum for our National Collection. They will in the New Natural History Museum at South Kensington be more accessible for study than at Bloomsbury, and as they contain great numbers of type specimens, will be invaluable for purposes of reference to both British and foreign palæontologists

Mr. Searles Wood, as Treasurer of the Palæontographical Society, took the heartiest interest in its success, to which his own labours have to such a great extent contributed. Those who had the pleasure of a personal acquaintance with Mr. Searles Wood will ever remember the kindly and genial manners by which he was distinguished.

J. W. J.

NOTES

The following is the list of officers and council of the Royal Society nominated for the year ensuing The election will take place as usual on St Andrew's Day, November 30:—President — William Spottiswoode, M.A., D.C L., LL D , Treasurer—John Evans, D C L , LL D , Secretaries—Prof George Gabriel Stokes, M.A., D C.L., LL.D , Prof. Thomas Henry Huxley, LL.D , Foreign Secretary—Prof Alexander William Williamson, Ph.D.; other members of the Council—William Henry Barlow, Pres Inst. C.E ; Rev. Prof. Thomas George Bonney, M.A , George Busk, F.L S , Right Hon. Sir Richard Assheton Cross, Edwin Dunkin, V.P.R.A.S., Alexander John Ellis, B.A., Thomas Archer Hirst, Ph.D , William Huggins, D.C L , LL D , Prof John Marshall, F.R.C S., Prof. Daniel Oliver, F L S , Prof. Alfred Newton, M.A , Pres. C.P.S.; Prof. William Odling, M.B , V.P.C.S.; Henry Tibbats Stainton, F.G S.; Sir James Paget, D.C.L , William Henry Perkin, Sec C.S , Lieut-General Richard Strachey, R E , C.S I

It is proposed to erect a monument to Spallanzani in Scandiano, where the distinguished naturalist was born in 1729 A committee for the promotion of the scheme has been formed there, and at Reggio and Modena A monument in marble is contemplated, more or less splendid according to the sum provided, and it will be inaugurated on *August* 21, 1885 (if circumstances do not allow of an earlier inauguration). The committee meanwhile propose (if practicable) to publish a new and accurate edition of the writings of Spallanzani, including some which have not hitherto appeared. Contributions are hoped for not only from Italians, but from foreigners generally among whom the work and principles of Spallanzani are honoured.

M. Leon Humblot, a well-known *naturaliste-voyageur*, has just returned to Paris from Madagascar with large and valuable collections Amongst the living specimens (destined for the Menagerie of the Jardin des Plantes) are two examples of the aye-aye (*Chiromys madagascariensis*), which, M Humblot maintains, it is now more difficult to procure in Madagascar than in Europe, a pair of the rare carnivore *Cryptoprocta ferox*, and specimens of several of the smaller lemuroids. M. Humblot has also brought a valuable series of mammals and birds in skin and a large collection of orchids.

No naturalist who visits Florence should omit to inspect the series of Italian vertebrates which has been brought together in the Reale Istituto degli Studii superiori, by the exertions of Prof. H. H. Giglioli The collection embraces a series of authenticated specimens of mammals, birds, reptiles, batrachians, and fishes from every part of Italy and the adjoining districts which belong essentially to the same fauna, arranged in systematic order, and is far more complete than any other Italian collection of the same sort. Prof. Giglioli is preparing a catalogue of this collection as a basis for a new "Fauna Italica."

On the 1st inst a very fine Naval and Marine Engineering Exhibition was opened in the Corporation Galleries, Glasgow, altogether probably the finest exhibition of the kind we have had in this country. It is divided into five sections:—1 Naval architecture, including war vessels, sailing ships, paddle and screw steamers, yachts, dredges, and miscellaneous craft, boats and life-boats, (2) Marine engineering, including engines and parts of engines, boilers and boiler appliances, &c , governors , (3) Equipment, including anchors, boat-lowering apparatus, pumps and hydraulic machinery, steering-gear, telegraphs, windlasses, &c., machines and tools; (4) Navigation and harbour works; (5) Miscellaneous. The first section is of special interest, containing models of vessels of all ages and of all kinds, from

the *Henry Grace de Dieu* (A.D. 1514) down to the *Livadia*, many of these models having been lent by the Admiralty. Prefixed to the carefully compiled catalogue is a sketch of the rise and progress of steam navigation, more especially on the River Clyde, by Mr. W. J. Miller, C.E. The success of this exhibition is largely due to the energy and tact of the Curator of the Glasgow Industrial Museum, Mr. James Paton.

"THE Journal of the Indian Archipelago," founded and edited by the late J. R. Logan, which was published at Singapore, and ceased to appear some years since, has always been accepted by ethnologists as a valuable contribution to Malayan literature. Some of the early volumes, especially the first, have long been out of print, but Mr. David Logan, the son of the late editor, who was recently in England, has reprinted the scarce ones, thus enabling complete sets of the work to be obtained. Messrs. Trübner are, we believe, the agents in London.

THE very large and extensive entomological collection made by the late Jno Miers, F.R.S., has been presented to the Ashmolean Museum at Oxford, and is now being studied and incorporated by Prof. Westwood. This collection is particularly rich in Brazilian insects, and thus becomes peculiarly valuable for the Oxford collection, which was, compared with other regions, poor in the neotropical fauna.

THE British Museum will shortly acquire the splendid collection of Heteromerous Coleoptera formed by Mr. Frederick Bates.

SOME unbelievers insisted that the submarine crannog described by Mr Ussher at Ardmore, Co. Waterford, was only the remains of an old salmon weir, the late storms however seem to have set this theory at rest, as they have cut out the peat to seaward of the crannog and exposed the ancient kitchen midden, also additional piling not previously known.

AT the last meeting of the St. Petersburg Society of Naturalists Prof Wagner exhibited the hydroids and medusæ of the White Sea he has brought home, giving a detailed description of ten species of medusæ he has discovered in that sea.

AT the last meeting of the St. Petersburg Horticultural Society M Wolkenstein exhibited a new variety of vine which grows and fruits at Warsaw and Riga. M. Wolkenstein thinks it might fruit even at St Petersburg. We notice also a communication by Prof Regel on apples.

PROF. SILVANUS THOMPSON has an interesting article in the current number of *Brain* on "Optical Illusions of Motion."

WE learn from a paper published by M. Goulishambaroff in the *Journal* of the Russian Physical and Chemical Society, vol. xii. fasc. 5, that the whole of the naphtha region of the Apsheron Peninsula has an area of 4·3 square miles, which may be divided into two parts, that of Balakhany, which has given naphtha since the oldest times; and that of Sabountchi, which was explored only in 1873. The first part contains forty-seven naphtha-wells, of which only twenty-eight are productive, and yield together 6,192,000 lb. of naphtha daily. The density of this naphtha varies from 0·855 to 0·885, the average density being 0·8675; whilst the naphtha of the Sabountchi region has a density of from 0·820 to 0·860, and is extracted to an average quantity of 6,622,000 lb. The density varies from the most different causes: it varies in different wells, and usually it might be said that in the same bore the density diminishes with the depth; however, heavy naphtha is received also from very near to the surface; usually it becomes heavier when the evaporation of volatile gases is rendered easy by local circumstances. Contrary to established opinion, M. Goulishambaroff proves that the naphtha of the Apsheron Peninsula contains volatile products of a density of 0·62, but no use is made of them because of the imperfect means of purifying. The amount of photogene received varies very much, namely, from 15 to 85 per cent., the naphtha which has a density of 0·890 to 0·900 giving the lowest, and that of a density of 0·820 giving the highest, percentage; the most usual kinds of naphtha (density 0·863 to 0·870) usually give from 35 to 40 per cent. of photogene. It shows, he stated, however, that thorough measurements of the coefficient of dilatation of naphtha having not as yet been made, there remains a certain want of precision in the determinations of its specific weights.

ON the night of the 3rd inst. a magnificent display of aurora was seen from various parts of the country. We have received several communications on the subject. Mr. E. W. Prevost writes from Cirencester that the display was visible there from 6 p.m. up to about midnight. "The glow, which extended over an angle of about 100°, rose upwards to a height of 20°, leaving the central portion comparatively dark. Faint streamers occasionally showed themselves, reaching 35° in height. A shifting of the streamers from east to west was noticeable, the illuminated arc being at times extinguished on the eastern side, this extinction progressing slowly towards the centre of the arc, when the light would reappear at the eastern side. At no time, as far as I observed, did the light disappear on the western side, the colour was of a greenish yellow and the wind due north." From Bootham, York, November 3, Mr J. Edmund Clarke writes: "There is quite a brilliant aurora this evening, first noticed about 6.30 as a diffused light shifting from north-east to south-west, with occasional streamers. Now (7.30-8.45 p.m.) it forms a low bright arch of considerable intensity. I said 'first seen about 6.30,' but at 4.40 I called the attention of a friend to some sharply defined red streamers in the north-east, which I then took to be sunlight. On August 12 last, about ½ to ¾ hour after sunset, my attention was called to streamers precisely similar, in every respect like those of the aurora. But careful observation showed that these were certainly radiating *from* the sun, and not converging *towards* the magnetic pole. It is certainly my impression that such was the case to-night, but being busy I did not take any special pains to ascertain. Of course this double coincidence may be a pure accident, but is it not possible that the minute substances reflecting the solar rays are actually modified by the electric field, so as to produce this remarkably distinct variety of rays? P.S.—8 p.m. Brilliant streamers from the bright arch, with some corruscations." Prof. Reilly, of the Royal College of Science for Ireland, writes that in Dublin the display was very fine. "The principal beam appeared as if slowly moving from west to east, and had a direction quite parallel to the pointers of the Great Bear. It reached at the time when seen quite up to the Polar Star. The lights were observed at earlier hours, one person having mentioned to me 6 o'clock p.m." In Orkney it showed itself as one of the most brilliant displays of aurora borealis seen for a long time. The whole northern horizon was one dark mass of clouds with a sharply defined edge, and from these the aurora shot up in beautiful coloured streams to nearly the zenith, covering the clear sky above the clouds from north-east round to north-west. Occasionally the aurora took the form of a gigantic rainbow, and the light was as bright as moonlight.

A SMART shock of earthquake occurred on the 9th inst. throughout Southern Austria, from Vienna to the Adriatic and the frontiers of Bosnia. In the capital a rather violent shock was felt at a quarter to eight. Numerous telegrams have been received by the Meteorological Bureau at Vienna stating that shocks were felt at Serajevo, Derwenta, Brod, Pola, Trieste, Zilli, Klagenfurt, Fünfkirchen, Odenburg, Marburg, Laibach, and Gross-Kanischa. In Agram, the capital of Croatia, three shocks of earthquake occurred, a period of an hour intervening between the second

and third. One of them, which lasted ten seconds, was so powerful that not a single house remained uninjured. A general panic reigns in the town. Many of the inhabitants, including the Cardinal-Archbishop, have taken to flight It is impossible to estimate the whole extent of the damage. The number of persons injured is at present estimated at thirty.

THE eruption of Vesuvius continues to increase in activity Two large streams of lava are at present (November 8) flowing from the crater to the base of the cone

IN Prof. Huxley's article on the *Challenger* Publications last week, line 11 from top of p 2, col 2, should read "*direct* and but little modified descendants," instead of "*dried*," &c

OUR ASTRONOMICAL COLUMN

HARTWIG'S COMET (1880 *d*).—In a circular issued by Prof. Winnecke from the Observatory of Strasburg on the 1st inst., he gives reasons for assuming that the comet detected by Dr. Hartwig on September 29 may have a much shorter period than was conjectured in his first circular On calculating parabolic elements from the Strasburg observations of September 29 and October 8, and one by Prof Auwers at Berlin on October 17, MM Ambronn and Wislicenus, students in the University of Strasburg, found the middle observation could not be more closely represented than with an error of something over two minutes of arc. Prof Winnecke, as was stated in our previous notice, considered he had reason for suspecting the identity of Hartwig's comet with that of 1506, and a further examination of the historical descriptions has led him to direct attention to the comets of 1382, 1444, and 1569, and with the perihelion passage fixed to July 13, 1444, and October 15, 1569, he finds geocentric positions which he regards as in sufficient agreement with the records. A period of revolution of about 62½ years is therefore obtained, and an ellipse with this period has been adapted by Dr. Schur and Dr. Hartwig to the observations on September 29 and October 14 and 24. The resulting elements are as follow :—

Perihelion Passage, 1880, September 6 58949 M.T. at Berlin.

Longitude of perihelion		83 33 28	M. Eq. 1880 0
„ ascending node		44 33 30	
Inclination	...	38 8 56	
Log. excentricity	.	9 990180	
Log semi axis major		1 196457	
Log mean diurnal motion		1 755321	

The error of the place deduced from this ellipse on October 14 is + 28″ in longitude and the same in latitude, and it is remarked that the error in longitude does not admit of being destroyed without an increase of error in latitude. This, however, Prof. Winnecke suggests, may arise from the assumed period of 62½ years being really a multiple of the true one The comet approaches near to the orbit of Mercury at the ascending node, though at the present time not sufficiently close to occasion any change in the character of the orbit Still at some past epoch the effect of perturbation may have brought the orbits into coincidence or nearly so, and Prof. Winnecke hints that the planet Mercury might have been the means of impressing an elliptical form on the comet's orbit.

It is clearly a case in which those observers who are in the possession of very powerful instruments may render most material service towards deciding whether we have to do with a comet of comparatively short period. If it is practicable to secure good observations for position after the next period of moonlight, it may then be possible to obtain evidence *pro* or *con*, by direct computation of the orbit, though unfortunately observations did not commence until the comet had reached the extremity of the parameter, or in other words had attained an angular distance of 90° past the perihelion point.

DISCOVERY OF A COMET.—Lord Lindsay notifies the discovery of a comet at his observatory, Dunecht, during the night of the 7th inst., by Mr Lohse in the constellation Lacerta; the position at 15h. 30m. in R.A. 22h. 45m. 54s., Declination 42° 33′ 7, daily motion in R.A. + 6m 58s., in Decl. + 1° 8′. This is far from any position which the expected comet of 1812 could occupy on the above date

CERASKI'S VARIABLE STAR —Mr Knott obtained a very complete observation of the descending and ascending light curve of this newly-detected variable on November 2; the minimum appears to have occurred about 11h. G M T. The period will be somewhat less than 2½ days.

PHYSICAL NOTES

PROF. LORENZ has given in *Wied. Ann*, No 9, a development of his theory of "refraction-constants" (published before in Danish), and described experiments bearing on it. The problem contemplated was to find that function of the refractive index, freed from dispersion, and of the density of a body, which is constant with varying density of the body, supposing the molecules themselves unchanged. It is assumed that bodies consist of molecules in whose intervals light is propagated with the same velocity as in vacuous space, further, that the bodies are isotropic, and their molecules of spherical form. Herr Lorenz arrives at a simple expression for the refraction-constant, the constancy of which, as also the correctness of the assumption as to light moving with the same velocity in the intervals of molecules as in vacuo, had to be proved He determined the refraction constants of several bodies in the liquid and the vaporous states, viz, ethylic ether, ethylic alcohol, water, chloroform, ethylic iodide, ethylic acetate, and sulphide of carbon. The refraction was determined with sodium and lithium light, and at temperatures of 10°, 20°, and 100°. He found that in passage of the substances from the liquid to the vaporous state the refraction-constant varies very little (only about 5 per cent at most) Dispersion also showed great constancy. Another Danish physicist, K. Prytz, has extended the inquiry to some ten other substances (*loc. cit*), and confirmed the assumption of refraction constants.

WITH regard to electricity, Herr Hoorweg (*Wied Ann.*, No 9) divides all bodies into two groups, (*a*) those in which the conductivity rises with the temperature (dielectrics), and (*b*) those in which it decreases with rise of temperature (adielectrics). He endeavours to prove by experiment (1) that both dielectric bodies with adielectric, and adelectric with each other, yield contact electricity, (2) that this electricity has always the same sign as that which arises with gentle friction or pressure. (The sometimes different action of strong friction is ascribed to the influence of the raising of temperature.) Not only does electricity arise through the different heat-motion at the places of contact of two heterogeneous substances, but this cause is fully sufficient to explain all development of electricity.

HERR NARR has lately obtained some interesting results in experimenting further on the behaviour of electricity in gases, and especially *in vacuo* (*Wied. Ann*, No 9). In the middle of a hollow brass sphere on a glass support was suspended a metallic ball by means of a platinum wire passing (insulated) through a metallic stopper to an electrometer Vacua could be produced in the sphere A charge of electricity imparted to the conducting system underwent the same process of dispersion *in vacuo* as where the space was full of gas. The outer surface of the hollow sphere, one minute and also one hour after the charging, had the same electricity as the conducting system Herr Narr further finds that the process of dispersion in gas-filled space is not perceptibly influenced by the hollow sphere being insulated or being connected to earth, if the original charging be done while the sphere is connected to earth; the dispersion constant diminishes in both cases, at least at the beginning But if the conducting system be charged while the hollow sphere is insulated, the latter has in this state one minute, and likewise one hour to one hour and a half after, electricity of the same sign with the conducting system, and the first connection of the hollow sphere to earth occasions a temporary outflow. Herr Narr shows reasons for believing that the electricity on the hollow sphere finds its way through the gas space.

A NEW series of experiments of extended range, by Herr Roth, on the compressibility of gases, is described in *Wied Ann.*, No. 9. The relations between pressure, volume, and temperature, in the case of carbonic acid, sulphuric acid, ammonia, and ethylene, are studied. The results are mainly confirmatory of van der Waal's formulæ.

A NEW balance designed to be easily transportable, light, and yet stable, without fixing to the table, and to serve in inspection of widely various weights (by Government officials in Hungary), was lately brought before the Buda-Pesth Academy by Herr von Kruspèr (see *Wied. Beibl.* No. 9, p 638) Among other features,

the prism-shaped steel bed, on which the middle knife-edge rests, is easily drawn out with the finger from the swallow-tail shaped rollers between which it is passed in the body of the balance. The beam can thus be easily removed and replaced. The balance rests on four feet. The stopping and raising arrangement is contained in a horizontal frame. Each weighing scale hangs on a conical point. Passing on to the reading, we find that the accuracy with which the balance works is, with 20 kg. weight, 2mg., with 500, 3½ mg.; and this is gained by substituting for the pointer an optical arrangement on the beam, consisting of two achromatic glass prisms, which render parallel the rays from opposite directions and send them to a telescope placed before the balance. At the two sides of the balance, about 2m to 4m from the middle knife-edge, two scales are set (best on the walls of the room); the images of these scales move in the field of the telescope beside each other in opposite directions, and so the corresponding divisions can be read off. These readings are independent of vibrations of the telescope, and are much more exact than those with telescope and cross threads, not to speak of the common pointer. The arrangement also permits of the centre of gravity of the balance being placed lower, the stability increased, &c. The weight of the balance is scarcely 20 kg, though both scales can carry 20 kg. weight

EXPERIMENTS by Forbes in 1831 and by some others since seemed to warrant the view, now commonly held, that the metals fall into the same series as regards conduction of electricity and conduction of heat, that the quotient of the heat conductivity by electric conductivity is nearly constant. Herr H. F. Weber, inclined to doubt this as contradicting the view (proved for gases and liquids) that the amount of heat transferred within a substance from layer to layer is most intimately connected with the specific heat of unit volume, made new experiments in this relation (which he has described to the Berlin Academy). He measured the heat-conduction by observing the cooling of various metal rings in a space at constant temperature, and the electric conducting power of the same rings, by noting their deadening effect on the oscillations of a magnet. The result confirmed his anticipations, the quotient of heat-conduction by electric conduction being found in the closest connection with the specific heat of unit volume. Experiments by a different electrical method for metals conducting electricity badly (lead, bismuth, &c.) and for mercury gave the same result. (Ten metals in all were examined.) On the other hand, non-metallic conductors of electricity do not show the relation in question, *e.g.* the heat-conduction of carbon is at least twenty to thirty times greater than that calculated from the electric conductivity and the specific heat. Thus the relation seems to be connected with the metallic nature of the substance. Herr Weber found the heat-conducting power of all the solid metals examined to decrease with increasing temperature, but at a considerably less rate than the electric conductivity. He further offers explanations of the erroneous view adopted, noting, *inter alia*, that the experiments in one case, though exact, were on too few metals, and these had nearly the same specific heat.

PROF. R. B. WARDER of Haverford College (Pennsylvania) and Mr. W. P. Shipley have investigated the configurations assumed by floating magnets in a magnetic fluid. They have modified Prof Mayer's original experiment by surrounding the vessel of water with a coil of wire traversed by a current, thus producing a field of force which, while still symmetrical about the centre, differs in several respects, the lines of force not being so greatly concentrated near the centre. Diagrams of various configurations are given by these experimenters in the *American Journal of Science* for October. As even a single one-fluid cell produces a current sufficient to show these results, they ought to be easy of repetition.

A COMPREHENSIVE memoir on the theory of the radiometer, by M. Mees, appears in the *Proceedings* of the Amsterdam Academy, and (in pretty full abstract) in *Wied. Beibl.*, No 7. The author, after criticising the various theories that have been enumerated, which he arranges in three classes, offers his own explanation of the phenomena (which cannot be briefly stated here).

A FEW months ago we drew attention to certain results published by Herr Exner of Vienna, relative to thermoelectricity, and which were at variance with all the body of evidence existing in that branch of science. Herr Exner had in fact asserted that an antimony-bismuth couple possesses thermoelectric powers only so long as one of the two metals is in contact with oxygen or with a gas capable of acting on one of them. The wish we then expressed that some independent observations might be made by other physicists has met with a response across the Atlantic. Prof. C. A. Young of Princeton, N J., communicated to the recent meeting of the American Association a paper on the thermoelectric power of a platinum-iron couple *in vacuo*. The crucial experiment was made with an exhausted glass tube containing an iron wire with platinum terminals, the terminals being again fastened to iron wires leading to a galvanometer. The tube was exhausted to one millionth of an atmosphere. On laying the apparatus in the sunlight and alternately shading the internal or external junctions an electromotive force could be produced, which was found to be equal in every case. The conclusion Prof. Young draws from the experiment is that Exner is wrong in his statement that thermoelectric electromotive force is due to the action of the gaseous media in which the metals are plunged. The experiment was conducted in Mr. Edison's laboratory at Menlo Park.

GEOGRAPHICAL NOTES

THE glacier of the Zarafshan, one of the greatest in Central Asia, which has hitherto been very imperfectly known, was explored during this summer by MM. Mushketoff, geologist, and Ivanoff. The exploration was quite successful, and at the last meeting, October 26, of the Mineralogical Society at St Petersburg, Prof. Mushketoff read a paper on his explorations. The lower extremity of the glacier is at the height of 9000 feet. The Galtcha people, who inhabit the upper valley of the Zarafshan, have never ascended the glacier, they say that on the summit of it there are two great pillars of stone, between which the traveller must go, and that the pillars would certainly crush together if any one ventured into the icy solitude. On August 25 the party began the ascent of the glacier on a very steep slope covered with blocks and moraines. A tunnel, no less than 3500 feet long, runs under the glacier, being the bed of the Macha River. After two days' travel the party had done seven miles on the glacier. The temperature during the day was as high as 40° Cels., and during the night as low as − 8°, some Galtchas who accompanied the party fell ill with fever. On the fourth day the party reached the first watershed, or rather the first iceshed, the whole length of the glacier to this point was sixteen miles, the width being one mile, six other glaciers, each of which is greater than the greatest Alpine glaciers, fed the principal one. At the head of it there is a wide *cirque* opening to the east; several peaks around it reach 20,000 feet. The descent on the other slope of the mountain ridge was far more steep and difficult than the ascent, the crevasses are very numerous and the glacier has several great "ice-falls," the inclination of which is no less than 50 degrees; the party was compelled to make use of small anchors and to cut steps in the ice. Two men were unwell and quite unable to go further when the party reached the foot of the eastern slope, after a very difficult journey.

THE last number of the *Izvestya* of the Russian Geographical Society contains a letter from Dr Miklukho-Maclay. After having visited the islands of New Caledonia, Lifu, New Hebrides, Admiralty, Louisiade, &c., he reached, about the end of January, 1880, the south-eastern coast of New Guinea, here he explored several points of the coast, and thence went to the islands of the Torres Strait and to Somerset, to study the population of Northern Australia. On his voyage from Vaihan Island to Sydney he stopped at several points of the eastern coast. From Sydney M. Maclay proposes to go to Japan, and thence to return to Russia. During his stay in Brisbane he was very kindly received by the local government and by private persons, who have much facilitated his anatomical studies by allowing him to work in the old museum and to make use of the photography of the topographical department. The journey in the interior of Queensland was very much facilitated by the cordial reception he received from the squatters, and by the kind permission to travel gratuitously along all the railways. M. Maclay expresses, in a letter addressed to the *Golos*, his thanks to the Australians for the reception he met from them, and wishes that all men of science were so kindly received in Russia. On August 12 he was in the house of J. B. Bell at Jimbor, near Dalby. The Russian public subscription has already reached 606*l*. which he received at Sydney.

A GOOD example is being set by the Tashkent College. During the summer fourteen pupils of the College, under the

direction of their Professor of Natural History, M. Shelting, made an excursion in the Ala taou Mountains. Numerous measurements of heights were made during the journey, good zoological, botanical, and geological collections, for the Museum of the College, were made, and a detailed diary of the excursion was kept by the scholars. The students of the Tashkent Normal School, as well as the pupils of the College of Verny, have also made scientific journeys for the exploration of the neighbourhood, and we learn that the College of Orenburg has requested tickets at reduced rates from the railway company for undertaking next summer a series of explorations in that little known but very interesting province. We cannot but wish that the colleges and schools of Western Europe would follow these examples; what an excellent training in natural science might thus be given, and what a mass of valuable information might be collected

THE members of the scientific expedition which was sent out by the St. Petersburg and Moscow Societies of Naturalists for the exploration of the White Sea and of the Murmanian coast of the Arctic Ocean, and which consisted of Professors Wagner, Bogdanoff, Tsenkovsky, and eight students of the University, have returned after having done some very successful work; they bring home very rich zoological and geological collections. Professors Wagner and Tsenkovsky stayed throughout the summer at the Solovetsky Islands, M. Lavroff in Kandalaksha Bay; Prof Bogdanoff travelled along the whole coast to Vadso; MM. Koudravtreff and Pleske, geologists, have travelled from Kandalaksha to Kola, others have explored the flora and the fauna of the ocean, Prof. Bogdanoff has also studied the fishing.

BARON A. VON HUGEL is now engaged in writing a work upon Fiji, where he travelled and spent some time, making extremely extensive and complete anthropological collections The work will be more particularly an ethnological one, and most of the weapons, fabrics, and other ethnographic articles are being figured to accompany the text The crania collected by Baron von Hugel have already been acquired by the Royal College of Surgeons, and exhaustively described by Prof. Flower.

WE notice the appearance of an important work published by the Russian Geographical and Economical Societies in the first volume of a "Collection of Materials for the Knowledge of the Russian Commune." It contains detailed descriptions of the communes of the Governments Ryazan, by M Semenoff, president of the Russian Geographical Society, MM Litochenko, Zlatovratsky, Mme. Yakouchkin, &c, a very complete bibliographical index of the literature concerning the communes of Russia and of Western Europe.

A TELEGRAM has been received at St. Petersburg from Col. Prejevalsky, dated from Urga, the 1st inst., stating that during the spring and summer of this year he surveyed a part of the basin of the Upper Hoang-ho and the Lake Koko Nor. He also passed through Alashan, in the centre of the Gobi desert, to Urga. Col Prejevalsky states that during the expedition he traversed a distance of 7200 versts, and that he has succeeded in obtaining valuable scientific results

THE death is announced, on his passage home from West Africa, of Count de Semellé, who has been recently exploring on the Lower Niger.

THE new *Bulletin* of the Société Khédiviale de Géographie contains a paper by General Purdy-Pacha on the country between Dara and Henfiah El Nabass, together with a map of that portion of Darfur, and another on Medina twenty years ago, by Col. Mohamed Sadik-Bey, illustrated by two engravings.

THE Church Missionary Society have received news that the Rev. P. O'Flaherty, their new agent in Uganda, and Mr. C. Stokes, with the Waganda chiefs and a large caravan, started from Saadani for the interior on August 9, but in little more than three weeks Mr. O'Flaherty was taken ill at Kidete, and will be unable to proceed to the Victoria Nyanza at present.

THE same Society have also received letters from various members of the Nyanza mission, giving a much more favourable report of their position in Uganda than had reached England some time back. Rev. G. Litchfield had in consequence of ill-health made an attempt to push northwards to Lado, in order to consult Dr. Emin Effendi. In this he unfortunately failed, being stopped by Kabba Rega, the king of Unyoro, who has seized M'ruli and other posts vacated by the Egyptians since Col. Gordon's departure. Mr. Litchfield accordingly returned to Rubaga, and, crossing the lake, proceeded to Upui, hoping eventually to get to Upwapwa, where Dr. Baxter is stationed.

MESSRS CAMERON AND PIGOTT, of the China Inland Mission, have made a journey of eight months through a great part of Manchuria and a portion of Mongolia. From the treaty port of Newchwang Mr Pigott went on to Moukden, while Mr Cameron proceeded along the coast in an easterly direction by the borders of Corea, and then northwards to Moukden. They next journeyed through part of Mongolia into Kirin, which at first they found fertile and well-wooded, but afterwards the country became wild, poor, and sparsely populated. The city of Kirin was reached by a long steep descent through fine scenery Fine teams of oxen were here met with, comparing favourably with some of our best breeds. After spending a few days at Kirin the two missionaries returned overland to Peking, passing the Great Wall at Shan hai kwan or Ling-yu-hsien

MESSRS. RILEY AND CLARKE, of the same Society's station at Chungking, have recently paid a visit to some Lolo villages in Southern Szechuen These mountaineers for the most part live in inaccessible fastnesses beyond the reach of the Chinese authorities, and are not confined to Szechuen and Yunnan, but under the designations of Laos and sundry other names are found throughout the extensive regions of Annam, Siam, and Burmah. Hardly anything is yet known of the Chinese Lolos and their manners and customs, but before long the agents of the China Inland Mission in the south-west will, it may be hoped, find means to collect information regarding them.

ON A DISTURBING INFINITY IN LORD RAYLEIGH'S SOLUTION FOR WAVES IN A PLANE VORTEX STRATUM[1]

LORD RAYLEIGH'S solution involves a formula equivalent to $\frac{d^2 v}{dy^2} \left(m^2 + \frac{\frac{d^2 T}{dy^2}}{T - \frac{n}{m}} \right) v = 0$

Where v denotes the maximum value of the y-component of velocity,

„ m „ a constant such that $\frac{2\pi}{m}$ is the wave-length,

„ T „ the translational velocity of the vortex-stratum when undisturbed, which is in the x-direction, and is a function of y,

„ n „ the vibrational speed, or a constant such that $\frac{2\pi}{n}$ is the period.

Now a vortex stratum is stable, if on one side it is bounded by a fixed plane, and if the vorticity (or value of $\frac{dT}{dy}$) diminishes as we travel (ideally) from this plane, except in places (if any) where it is constant.

To fulfil this condition, suppose a fixed bounding plane to contain ox and be perpendicular to oy, and let $\frac{dT}{dy}$ have its greatest value when $y = o$, and decrease continuously, or by one or more abrupt changes, from this value, to zero at $y = a$ and for all greater values of y

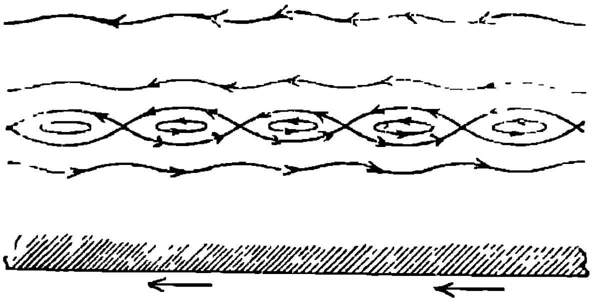
It is easily proved that the wave-velocity, whatever be the wave-length, is intermediate between the greatest and least values of T. Hence for a certain value of y between 0 and a, the translational velocity is equal to the wave velocity, or $T = \frac{n}{m}$. Hence for this value of y the second term within the bracket in Lord Rayleigh's formula is infinite unless, for the same value of y, $\frac{d^2 T}{dy^2}$ vanishes

We evade entirely the consideration of this infinity if we take only the case of a layer of constant vorticity $\left(\frac{dT}{dy} = \text{constant}\right.$ from $y = o$ to $\left.y = a\right)$, as for this case the formula is simply

$$\frac{d^2 v}{dy^2} = m^2 v,$$

[1] By Sir William Thomson British Association, Swansea, Section A

but the interpretation of the infinity which occurs in the more comprehensive formula suggests an examination of the stream-lines by which its interpretation becomes obvious, and which proves that even in the case of constant vorticity the motion has a startlingly peculiar character at the place where the translational velocity is equal to the wave velocity. This peculiarity is represented by the annexed diagram, which is most easily understood



if we imagine the translational velocities at $y = 0$ and $y = a$ to be in opposite directions, and of such magnitude that the wave velocity is zero, so that we have the case of standing waves. For this case the stream-lines are as represented in the annexed diagram, in which the region of translational velocity greater than wave-propagational velocity is separated from the region of translational velocity less than wave propagational velocity by a cat's-eye border pattern of elliptic whirls.

MINERAL RESOURCES OF NEWFOUNDLAND

ORES of copper have been found in all the older formations in Newfoundland, from the Laurentian gneiss at the base, to the Carboniferous series at the summit, the qualities of which vary greatly with the age and condition of the rocks with which they are associated. Thus in the Laurentian series the rich ores of variegated and sometimes grey sulphide of copper are more frequent than any other, and are for the most part in white quartz veins intersecting the strata, but while these ores have in many cases been found on analysis to yield at the rate of from 50 to 70 per cent. of metal, the quantities available at any one place hitherto tested have never yet been found sufficient to warrant an outlay of capital.

In the succeeding series, which I conceive to be the equivalent of the *Huronian* of *Canada*, and have provisionally called *intermediate*, as being intermediately situated between rocks of the Laurentian and Primordial Silurian ages, very rich ores of copper are likewise well known at many parts, chiefly in white quartz veins, and also in faults and dislocations, particularly near the junction with the fossiliferous Primordial, in which cases the indications may sometimes be regarded as favourable for the probable future development of mines. Several attempts have already been made in this direction at various parts of the distribution of the series, but except at a few places, chiefly near the junction with the newer formations, with but slender prospect of a successful issue.

By reference to the Custom House returns of exports I find that the amount and value of copper ore shipped at St John's between the years 1854 and 1864 inclusive was as follows:— Ore, 627½ tons, value \$22,980 = 4,596*l* sterling. The places where this ore was raised are not specified, but I believe it was all derived from rocks of intermediate age, by which the greater part of the Peninsula of Avalon is occupied.

In addition to the above export from St John's, 544 tons, valued at \$19,179 were exported between the years 1875 and 1879; but a considerable, if not the larger portion of this ore was produced from Tilt Cove and other of the early openings in Notre Dame Bay.

Although the presence of copper is frequently indicated by stains of green carbonate and small nests of yellow sulphuret in the lower Primordial strata, I am not aware of any instances where the ores occur in mass, or in intersecting veins or lodes, except it may be close to their immediate junction with the older series on which they repose unconformably or butt up against in faults. At some parts of their distribution, such as in the islands of Conception Bay, these older Silurian rocks are but very little disturbed, resting in nearly a horizontal attitude, and scarcely at all altered, at other parts, such as Trinity Bay, St. Mary's Bay, Langlois Island of the Miquelons and elsewhere, they are greatly disturbed by intrusions of igneous rock, and occasionally to some extent metamorphosed, but they are almost everywhere crowded with organic remains, the types of which indicate the ages they represent, to extend from the horizon of Primordial or Cambrian to the newer Potsdam Group of the United States and Canada. Strata representative of Potsdam, Calciferous, and Levis ages, containing abundance of typical fossils, are extensively displayed on the western and northern parts of the island, the former in many cases resting directly on Laurentian gneiss unconformably, but, except it may be to a very limited extent in Canada Bay, near the Cloud Mountains, I am not aware of any deposits older than the Potsdam at these parts, nor have I seen indications of the presence of the Huronian or intermediate system north of Bonavista Bay, or anywhere near the western shores. Galena in calcareous veins is of frequent occurrence in these Lower Silurian rocks, but except in small isolated crystals or patches the ores of copper are particularly rare, and in no case such as to be considered economically valuable.

But the cupriferous formations proper of Newfoundland, according to my view of the structure, lie unconformably above all the former, and consist mainly of a set of metamorphic and igneous rocks, corresponding exactly in mineral character and condition with the rocks of the Eastern Townships of Canada described by Sir Wm. Logan under the title of the Quebec Group. I am quite aware that these views, as regards the structure, are at variance with those entertained by several distinguished geologists in Canada (whose opinions, however, do not seem to be very unanimous on the subject), and there cannot be a doubt that in many cases the evidences appear to be so contradictory at different localities that the difficulties in arriving at the truth are exceedingly great. Nevertheless, so far as my own observations go, and I have studied the succession at nearly all parts of their distribution in Newfoundland, I am led to the conclusion that the stratigraphical position of this metamorphic group belongs to a horizon intermediate between the Calciferous and Hudson River group, probably chiefly of Chazy age, which is in accord with the structure of Sir W. E. Logan.

The group consists of chloritic, dioritic, and felsite slates, interstratified with compact diorites, bands of red jasper, dolomites, great masses of serpentine, or serpentinous rock, and volcanic products. In nearly all these rocks the ores of copper are more or less disseminated, but it is amongst the schistose portions, especially the clorite slates, that they seem to be most abundant, and it is in rocks of that quality chiefly where the principal mining operations have hitherto been conducted. At some parts of the distribution these rocks are distinctly stratified, the lines of deposit being well displayed in layers of different quality: beds of jasper, conglomerate, &c. The whole series is magnesian, more or less, but particularly towards the top, which appears to be the horizon of the serpentinous masses, with large accumulations of volcanic ash. Towards the base the rocks become calcareous, the cliffs of strata much incrusted with carbonate of lime, and some strata of a pure white crystalline limestone occur which are fossiliferous. The fossils are too obscure to be identified with certainty, but one form bears a strong resemblance to a *Maclurea*, another to a *Bellerophon*, a third to a *Murchisonia*, and some rather large-sized *Encrinite* stems. Near the horizon of this limestone moreover we find a set of black slates which contain graptolites. Vast intrusive masses of granitoid rock, and great dykes of greenstone melaphyre and other traps intersect the formation.

The only mines of importance in active operation up to the present time are all situated in Notre Dame Bay, and these are Union Mine Tilt Cove, Betts Cove Mine, Colchester, in southwest arm of Green Bay, Little Bay Mine, Rabbit's Arm, and Seal Bay. Many openings and minor workings have also been made at various parts of the bay, at each of which the ores of copper were more or less indicated, some of which may eventually, when capital and skilled labour are brought to bear, be found sufficiently remunerative to be worked to advantage.

It will be seen by the annexed memoranda that the total value of the copper and nickel ore extracted since 1854, but by far the larger proportion since 1864, when the Union Mine Tilt Cove was first opened by Mr. Smith McKay, amounts to nearly one million sterling.

Memoranda showing the Quantities and Values of Copper and Nickel Ores exported from the Island of Newfoundland in the undermentioned Years

Years.	Parts cleared from	Copper	Nickel	Value	Value of nickel ore
		Tons	Tons	Dollars	Dollars
1854 to 1864	St John's	627½[1]		22,980	
1875 to 1879	,,	544½[2]		19,179	
	Total St. John's	1,172		42,159	
1869	Union Mine Tilt Cove	5,938	30	190,016	7,200
1870	,,	4,218	88	134,976	8,800
1871	,,	1,924	7	61,568	700
1872	,,	4,774[3]	8	152,768	25,60
1873	,,	5,414	233	189,490	9,320
1874	,,	4,346	—	104,304	—
1875	,,	4,838	17	179,006	1,360
1876	,,	6,464	28	232,704	2,800
1877	,,	5,389	—	194,004	—
1878	,,	4,450	—	97,966	—
1879	,,	1,964	—	35,352	—
	Total Tilt Cove	49,719	411	1,572,154	32,740
1875	Bett's Cove	6,280		232,360	
1876	,,	18,670		456,481	
1877	,,	42,065		1,093,768	
1878	,,	31,370		690,140	
1878	Regulus	750		34,500	
1879	,,	26,421½		475,587	
	Total Bett's Cove	125,556½		2,982,836	

The ores returned for 1878–79 were largely derived from Little Bay Mine and partly from Colchester, all belonging to the Bett's Cove Mining Company.

Thus the total value of the ores of copper and nickel exported since 1854 amounts to $4,629,889, or nearly £1,000,000 sterling.

ALEX. MURRAY

[1] Chiefly from Huronian rocks
[2] Partly from openings in Notre Dame Bay.
[3] Cloanthite and Millarite

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—In Groups C and E of the Higher Local Examination this year there were respectively fifty-four and ninety-nine candidates, five obtained a first class in Group C (Mathematics) and eight a first class in Group E (Natural Science), nine candidates failed in Group C, and twenty-six failed in Group E. Three candidates answered the questions in Differential and Integral Calculus, and showed considerable knowledge In botany a fair average of proficiency was attained, in geology the papers were below the average In zoology inferior text-books had been too much preferred, to the exclusion very largely of practical work The work in chemistry was unequal, but some candidates showed a very good acquaintance with the details of manipulation. Physics can scarcely be said as yet to be studied by the candidates. In physiology the answers were in some cases accurate and to the point, but the majority of candidates failed.

The elections to the Council of the Senate were made on Monday, and show in a very practical manner that residents are in favour of considerable improvement in University matters. Only one member who approves of the retention of Greek as a universal subject in the "Little-go" was elected, viz, Mr. G. F Browne, whose place in the Council is due to his active work in connection with the University Local Examinations and his knowledge of the intentions of the University Commissioners, as one of their secretaries.

Dr Phear, Professors Cayley and Liveing, and Mr. Peile, are among those who were elected to the Council well known for their scientific eminence and breadth of view.

Prof. Stokes, Lord Rayleigh, and Mr. Vines were added to the Council of the Philosophical Society at its annual meeting.

Mr Forbes, Prosector to the Zoological Society, has been elected to a Fellowship at St. John's College

AT an examination held on Wednesday, October 27th ult, Mr. M Milburn, of Longtoun, was elected to a vacant bursary in connection with the "Young" Chair of Technical Chemistry, Anderson's College, Glasgow. The bursary, which is of the value of 50*l.*, and tenable for three years, is the gift of Mr. James Young, LL D., F R.S., of Kelly and Dullis, founder of the Chair.

SCIENTIFIC SERIALS

Journal de Physique, October.—Experimental verification by S. Carnot, of the principle he discovered, by M Lippmann.—Apparatus and experiments for elementary demonstration in optics, by M Gariel —Influence of velocity of propagation of sound in the shock of elastic bodies, by M. Flie —New form of plates for air pumps, by M Terquem —*Proceedings* of the Physical Society of St. Petersburg (including papers, in abstract, on the chemical and photographic action of light, the transmission of the current in water with unequal platina electrodes, variations of volume and coefficient of elasticity of palladium and its alloys under the influence of absorbed hydrogen, &c.)

Rivista Scientifico Industriale, No 18, September 30 —On the relation between terrestrial storms and the planetary relations of the solar system, by Prof. Zenger.—Excursions (geological) in the neighbourhood of Modica, by Prof Lancetta.—Palæontological studies in Bohemia, by Prof. Fritsch.—Beats, the third sound of Tartini, and the differential resultant sounds of Helmholtz, by Dr Crotti.

No. 19, October 15.—New registering pluviometer, by S. Grimaldi —New apparatus with petroleum heating, by S Esser. —On a new variety (Rosterite) of Elban beryl, by Prof Grattarola

Kosmos, July 1880, contains a translation of Prof. Huxley's "The Coming of Age of the Origin of Species" (*vide* NATURE, vol xxii. p 1) —Dr Ernst Krause's sketch of the developmental history of the History of Development —Dr. H Muller, the importance of Alpine flowers in connection with the "flower theory"—H. Schneider, observations on some apes —Prof Dr Caspary, the conception of a soul and its significance in connection with modern psychology.—Short contributions and extracts from journals (among the short articles is one on the resemblance between flowers and fruit, by Hermann Muller, and on the occurrence of a five toed example of *Archibutio lagopus*, by W. von Reichenau)

August, 1880 —Dr Oscar Schmidt, the severance of species and natural selection.—Dr Ernst Krause, sketch of the developmental history of the History of Development, No 2 —Dr Herman Muller, on the development of the colours of flowers —Prof A H Sayce, on the history of writing (translation) —Short contributions and extracts from journals —Literature and critical notices.

Revue des Sciences Naturelles, September.—M Mathias Duval, on the development of the spermatozoa in the frog (Plates 3 and 4).—M Lavocat, on the construction of the extremities of the limbs —Dr A Godron, on the absence of a glume in the lateral spikelets of Lolium — M Leymerie, sketch of the Pyrenees of the Aude —Notices of French memoirs on zoology, botany, and geology —Bibliography and notice of the death of Dr. A. Godron

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, November 4.—Prof H E. Roscoe in the chair.—The following papers were read —On the compounds of vanadium and sulphur, by E W. F Kay The author shows that the products obtained by Berzelius are oxy-compounds, that the substance obtained by Berzelius in the dry way is a true trisulphide of vanadium V_2S_3, the disulphide and pentasulphide have also been prepared and are described in the present paper.—On the atmospheric oxidation of phosphorus and some reactions of ozone and peroxide of hydrogen, by C. T Kingzett The author concludes that in the above oxidation both ozone and peroxide of hydrogen are formed, the former

passes on in the current of air, the latter remains in the water in which the phosphorus is oxidised. In several experiments the proportion of peroxide of hydrogen to the ozone formed was as *1 to 2*.—On the action of zinc ethyl on benzoylic cyanide, by E. Frankland and D. A. Louis. The product of this reaction, an amber-coloured jelly, was first decomposed and then extracted with alcohol, about 3 per cent. of a substance $C_{24}H_{18}NO_2$, named provisionally benzcyanidin, crystallising in colourless needles, was obtained. Besides this body an unstable substance was obtained which could not be purified, but which on oxidation with bichromate gave propiophenone $C_9H_{10}O$. —On the action of zinc-ethyl on cyanogen, by E. Frankland and C. C. Graham. The product of this reaction was a solid mass, which on heating to 120° yielded a colourless liquid which was propionitrile C_3H_5N., the other product of the reaction being zinc cyanide.—On bismuth and bismuth compounds, by M. M. P. Muir, G. B. Hoffmeister, and C. E. Robbs. The relative stabilities towards heat and reducing agents of the oxides, and towards heat of the hydrates are discussed, also the action of chlorine and bromine on the oxides. An attempt is made to give structural formulæ for these bodies, in which bismuth is trivalent.—On the colour properties and relations of the metals copper, nickel, cobalt, iron, manganese, and chromium, by T. Bayley. The author has carefully compared the colours of solutions of salts of the above metals and various mixtures thereof, and especially those mixtures which yield colourless or neutral grey solutions.—Action of diazo-naphthalin on salicylic acid, by Percy Frankland.—On the basic sulphates of iron, by Spencer Pickering.—Fourth report on researches in chemical dynamics, by C. R. A. Wright, E. H. Rennie, and A. E. Menke.—On some naphthalin derivatives, by C. E. Armstrong and N. C. Graham.—On acetylorthoamidobenzoic acid, by P. P. Bedson and A. J. King.

VIENNA

Imperial Academy of Sciences, October 21.—On the propagation of ball and cylinder waves of finite width of vibration, by Dr. Tumlirz.—On the law of convulsive action (continued), by Prof. Stricker.—On the blood vessels of the valves of the heart, by Dr. Langer.—On the question of arrangement in the pyridin and chinolin series, by Dr. Skraup.—Experiments on the magnetic behaviour of iron, by Herr Haubner.—On the relation of the daily and yearly variation of temperature to the sun spot period, by Herr Liznar.

PARIS

Academy of Sciences, November 2.—M. Edm. Becquerel in the chair.—The following papers were read:—New observations on the etiology and prevention of *charbon*, by M. Pasteur. He gives a letter written by Baron von Seebach (Saxon Minister in Paris) to M. Tissandier in 1865, stating facts which afford striking confirmation of M. Pasteur's views as to the causes of the disease.—On the heat of formation of ethers formed by hydracids, by M. Berthelot. In these experiments he used his calorimetric detonator.—Heat of formation of sulphide of carbon, by M. Berthelot. The combustion of liquid sulphide of carbon liberates +246·6 cal. (Favre and Silbermann obtained 258·5 cal., but they overlooked the formation of sulphuric acid). Sulphide of carbon is formed with absorption of heat from its solid elements, but there is probably liberation of heat from gaseous sulphur and carbon.—On volcanic thunderstorms, by M. Faye. In paroxysmal eruptions the enormous amount of steam ejected causes volcanic thunderstorms, which are quite distinct from ordinary thunderstorms, especially in the absence of gyratory movements, the complete immobility of the volcanic storm (which is confined to the column of ascending clouds), and the fact that no flashes occur without the presence of ashes. The phenomena are very much those of the Armstrong electric machine. Further, there is never any mention of hail, and M. Faye thinks it is probably never produced, as it is the product of vast gyratory movements not found in volcanic clouds. He suggests the desirability of studying directly the traces of electricity in the vapours rising from the crater of Vesuvius.—On photographs of nebulæ, by M. Janssen. The photography of a very bright nebula is now comparatively easy, if one content oneself with the most luminous part, but extremely difficult if a complete image be sought comparable to those given by our large instruments. The latter is what we especially require, with a view to studying the important questions of variations of nebular structure, and calls for many able workers, furnished with the best instruments. M. Janssen is preparing observations of the kind at Meudon.—Observations of planets and comets, at Marseilles Observatory, by M. Stephan.—On the winter egg of phylloxera, by M. Valery-Mayet. It seems certain that the hygrometric state of the air, generally very dry in Languedoc (where the author is), is the great obstacle to production of the winter egg. Whenever the sea-winds, which always blow in autumn, bring that region to the conditions of the climate in the west, the egg is produced.—Elements of the orbit of the new planet (217) discovered by M. Coggia.—On the resolution of algebraic equations; examination of the method of Lagrange, by M. West.—On linear differential equations with rational coefficients, the solution of which depends on the quadrature of a rational function of the independent variable, and of an irrational algebraic product, by M. Dillner.—On a property of uniform functions of a variable connected by an algebraic relation, by M. Picard.—On the application of the photophone to study of the sounds which occur on the sun's surface, by Prof. Bell. This was suggested by Mr. Bell in visiting the observatory at Meudon. M. Janssen put all the instruments at his disposal, and an opportunity was taken to explore a solar image 0·65 m. in diameter with the selenium cylinder. The phenomena were not sufficiently marked to justify one in affirming success, but Mr. Bell is hopeful of succeeding. M. Janssen has suggested the method of passing rapidly before an objective which should give conjugate images on the selenium apparatus, a series of solar photographs of one spot taken at intervals sufficient to show notable variations in the constitution of the spot. This is to be tried.—On the oxidation of mannite, by M. Pabst.—On the ferments of albuminoid matters, by M. Duclaux. There are certainly over a hundred species, and of these he only knows twenty at present (the physiological conditions, *i.e.* of their existence). Previous classifications prove useless. He gives some general *traits*. *Inter alia*, in milk the ferments change the caseine into soluble albumen, but while the aerobian-ferments do this in a slow and regular way, the anaerobians do it with liberation of carbonic acid and hydrogen, part of which becomes sulphuretted hydrogen or even phosphides of hydrogen. In cheese-making the predominance of the aerobians has been unconsciously favoured. All the ferments studied are found in full activity in the stomach. They secrete soluble ferments, which are added to those of the organism.—Inoculation of symptomatic *charbon* by intravenous injection, and immunity conferred on the calf, the sheep, and the goat by this process, by MM. Arloing, Cornevin, and Thoma.

CONTENTS

THURSDAY, NOVEMBER 18, 1880

THE FUTURE OF POLAR RESEARCH

WE have had quite a flood of Arctic news during the last few weeks, and the question as to the direction to be taken by future Polar research is attracting attention in various quarters. Evidently those interested in this department of exploration are thinking that "something ought to be done"; but as to what that something should be, there is likely to be difference of opinion It is unfortunate that the United States expedition sent out at the instigation of Capt. Howgate to found a Polar colony at Lady Franklin Sound, had to turn back through some defect in the engines of the *Gulnare*. Had this ship been successful in reaching the proposed ground of the expedition's work it would no doubt have given an impetus to the scheme of Polar research which has gained the approval of the Arctic authorities of nearly all nations except our own On the other side of the American continent no news has been received from Mr Gordon Bennett's expedition in the *Jeannette* of later date than August, 1879, when that vessel was off Cape Serdze Kamen, all well, and on her way to Wrangel Land All the sea within Behring Strait, both on the American and Asiatic side, was searched this summer by the *Corwyn*, but no trace of the *Jeannette* was found. The conclusion from this that the expedition has come to grief, we have already pointed out is too hasty Everything was in her favour when off the coasts of Kamtchatka last year, and if she had fair sea-way there can be no doubt that the expedition would take advantage of it, and push on as far northwards as was safe. We should not be surprised if a year hence the *Jeannette* might emerge by Behring Strait or by Novaya Zemlya with news of equal importance to that brought back by the *Tegetthoff* years ago.

But perhaps the most generally interesting expedition on the part of the Americans is that which returned some weeks ago from searching for further relics of the crews of the *Erebus* and *Terror* With the details of this expedition our readers are already familiar. So far as further information concerning the fate of the Franklin expedition is concerned, the results have not been of much importance, though it would seem that the scientific results are of some value. What precisely these are remains to be seen. Had the handsome volume recently published by the U.S. Government under the able editorship of Prof Nourse, containing the narrative of Capt C F. Hall's second expedition, been issued before Lieut Schwatka set out two years ago, we doubt if he would have thought it necessary to go over the same ground again.[1] Hall's devotion to the memory of Franklin is well known, and his enthusiasm for Arctic exploration was almost a religion; his *Polaris* expedition will never be forgotten In order to obtain certain news of the fate of Capt. Crozier and the 105 men who, in April, 1848, abandoned the *Erebus* and *Terror*, Hall lived with the Eskimo in the neighbourhood of Repulse Bay and King William Land for five years, 1864–69. He, like Barry, also had heard of records possessed by the Eskimo, and to obtain these records he submitted to become an Eskimo himself for all these years. With infinite tact and patience he carried out the object of his expedition, succeeded in visiting the scene of the memorable disaster, saw many signs of the presence of white men, obtained many relics, heard many stories from eye-witnesses of the sufferings of Crozier and his men when trying to make their way to the Fish River, but obtained not a shred of any kind of record Among the things abandoned by the men in their last despairing efforts to reach a white settlement were certainly some books, but whether written or printed could not be ascertained. The poor Eskimo had no use for such strange things, and gave them to the children to play with, and long before Hall's visit all trace of them had vanished. Indeed the information he obtained was of pretty much the same character as that just brought back by the expedition under Lieut Schwatka The stories told to Hall by the Eskimo as to the wanderings and sufferings of the white men are interesting, though sad Apart from the immediate object of his expedition, Hall's long residence with the Eskimo, with whom he lived as one of themselves, yielded results of great interest He lived in their igloos, ate their food, wore their clothing, shared their joys and sorrows, joined in their feasts, their dances, and their hunts; in short, saw more of Eskimo life than probably any one has done before or since. The details given in his journals are a contribution of great value to a knowledge of the Eskimo, and the self-denial of the high-minded and sterlingly honest man in submitting to this kind of life for so many years, for so noble a purpose, raises him to the rank of a hero The volume edited by Prof. Nourse, with its many illustrations and handsome get-up, might well put our own Government to shame Prof. Nourse has done his part of editor admirably, and his volume will be of permanent value So successful has the work been that we believe a second edition has been issued As the work is only recently published, it may fairly be recognised as a contribution to a knowledge of the Arctic situation.

This is a good summer's work for America On the opposite side of the Pole some good work has also been done The Dutch in their tiny vessel the *Willem Barents* have done some good dredging in the sea between Spitzbergen and Novaya Zemlya, while Mr Leigh Smith has added greatly to his fame as an Arctic yachtsman by his work in Franz-Josef Land. He has as we have already told, greatly extended the known area of this archipelago, and shown fair grounds for believing that it extends polewards for a considerable distance He has proved, as was done last year also, that this Arctic land is by no means difficult to reach in an average year, and this has an important bearing on Arctic research. Last week we gave a few details of what had been done along the Murmanian coast and the White Sea by the Russian party under Prof. Wagner and we know that Baron Nordenskjold is spending the winter in St. Petersburg preparatory to undertaking his expedition next year to the New Siberian Islands.

All this is encouraging, though it would be still more so were these various efforts undertaken on some well-concerted plan. Already has the Geographical Society been asked to lend its influence to an expedition which we cannot but regard as an anachronism. We hear

[1] "Narrative of the Second Arctic Expedition made by Charles F. Hall." Edited under the orders of the Hon Secretary of the Navy, by Prof. J E Nourse, U S N (Washington Government Printing Office.)

much talk of the traditions of the English navy and the duty of England to be the first to reach the Pole. We fear the so-called traditions of the English navy must be made to conform to the requirements of modern science if she is to do any useful work in Polar discovery, just as they have been compelled to do in order that our navy may be able to keep abreast of the fighting power of other nations. To squander 30,000*l* in one huge attempt to reach the Pole would be as mad as for a merchant to embark all his capital in one hazardous undertaking Polar research and Polar expeditions are not incompatible, but as Dr Neumayer showed in an admirable address at the Danzig meeting of the German Association, the former must be subordinated to and guided by the results of the latter. Preparations are being made by nearly all the countries of Europe and by America for a regular Arctic siege, to begin in 1882, the days of Arctic campaigns are past We have reached the precincts of the citadel itself, and now the sappers and miners must begin their slow but sure work, to be capped at the proper time by a grand assault Germany, Austria, Norway, Sweden, Russia, Denmark, the United States, and we believe Canada are all to take part in this great work by establishing observing stations at suitable points all round the Polar area; while Italy is to send out next year a scientifically equipped expedition to the Antarctic region, our knowledge of which is meagre and uncertain This last will really be an observing as well as an exploring expedition, preparatory to the establishment of an Antarctic station. Should our Geographical Society take any steps in the direction of Arctic work, we trust it will not be to encourage the foolish venture for which the country has been canvassed for subscriptions for years. We hope that Society will see that as a scientific body, its duty is to encourage a scientific method of work, and if it appeals to Government at all, let it be to urge it, for the honour of our country, to join in the concert of both hemispheres for the siege of the Polar citadel We have already pointed out on several occasions the vast gains to science that might be expected from the work of a series of Polar observatories established on the plans so ably sketched by Lieut Weyprecht. As Dr Neumayer said in the address alluded to, men of science do not demand practical or so-called utilitarian reasons before giving their adhesion to any new work, it is enough if it can be shown that such work will conduce to the advancement of knowledge. And that Weyprecht's scheme of Polar observatories, of which so many Governments approve, will lead to vast additions being made to scientific knowledge, no man of science needs to be told. In meteorology, terrestrial magnetism, biology, geology, and glacial physics, the gains would be immense, and the history of science has taught us over and over again that the surest path to practical and beneficent results is through the gate of pure scientific research. Every day is the science of meteorology becoming more and more important, but until we are thoroughly acquainted with the meteorology of the Arctic regions, that most practical of sciences is deprived of what is perhaps its most important factor. But one element of the international scheme is that of Polar exploration, conducted, however, on scientific method, and along lines indicated by a scientific knowledge of Arctic conditions such as can only be obtained by permanent observing stations What success is likely to result from Arctic work carried out on such a method was triumphantly shown by Baron Nordenskjöld when he sailed along the North-East Passage in the *Vega*. Why then should not England set up a station on Franz-Josef Land, and another say on some part of the American coast? Let the station be provided with the means of carrying out exploration in whatever direction and by whatever means the results of continued observation may indicate —as far as the Pole itself, if need be. Unless we are blind to the teachings of science and the lessons of our last expensive expedition, it is clear that this is the only sure method of reaching the Pole, if it be thought absolutely necessary for the credit of England that she should be the first to get at a point which it will take considerable trouble to spot If our Government be well advised, we are sure they will never give the public funds either for any great national expedition modelled on the lines of the past, nor to any private chimera got up for the glory of one man and the gratification of balloonists We do not see how, without national discredit, England can keep aloof from an international scheme, the scientific and practical results of which will be of world-wide importance, and it is the duty of the Geographical Society to lend all the weight of its influence to induce the English Government to take up its share in the new and only effectual method of Polar exploration

THE SANITARY ASSURANCE ASSOCIATION

IT is admitted on all hands that a vast amount of unnecessary disease, suffering, and death is caused by defective sanitary arrangements, especially as regards drainage A few years ago, so long as there was no foul smell, and all the pipes were "properly trapped," everybody was satisfied, but properly trapped usually meant improperly ventilated, or not ventilated at all, and we know now that foul gases will pass steadily, continuously, and certainly through water in traps.

Clinical observation having demonstrated the fact that sewer air produced diseases, the prevention of the entering of such foul air into houses became of paramount importance; and the matter being thus brought to so narrow an issue, the application of well-known physical laws was all that was required; it was necessary to study the circumstances under which foul air was produced, to prevent its production as far as possible, and to take such precautions that foul air, even if formed, could not accumulate and could not find its way into houses

Science has done much, both directly and indirectly, towards the prolongation of life; and certainly not the least important of the results of the application of scientific methods to this end in recent years has been the discovery of the ways in which a house can be made practically sewer-air proof The laws of health are being studied more and more every day, and will soon be taught as a matter of course in all our schools; they are already recognised as a special subject of study at the Universities. People are beginning to perceive that their health is a matter which is very largely indeed in their own hands, and are beginning to turn this knowledge to account in the matter of house sanitation. At the first

meeting of the Sanitary Assurance Association, presided over by Sir Joseph Fayrer, eminent members of the two professions which must always occupy the most reponsible position in connection with household sanitary matters, the professions of medicine and architecture, bore ample evidence to this fact, and at the same time to the necessity for some organisation by which the benefit of the best advice on such matters may be brought within the reach of the many. At this meeting Mr. Mark H. Judge pointed out that the Association "was the outcome of efforts which had been going on for some months to bring together architects and medical men in connection with the important question of house sanitation," and the names already identified with the Association are a sufficient guarantee that it will be both practical and permanent in its character. Sir Joseph Fayrer rightly stated in his opening address that "there is a terrible absence of all supervision of sanitary arrangements and drainage in many of the houses of the metropolis," and that although the richer classes of the population are able to get that sanitary advice which will enable them to make their houses wholesome, "there is an enormous population left, as regards which such a thing is hardly possible." Saying that he believed the idea was beginning to grow that "sanitation generally will increase the value of life," he continued, "over and over again it has come to my knowledge, and even occurred under my own observation, that families, children and servants, have suffered by the defects of drainage or sewer air—that great enemy to public health. I would venture to offer no opinion as to the nature of the diseases that proceed from sewer air, nor even enter into any discussion on the precise character of the air—the nature of the germs and the character of the poisons that it communicates; but that it does destroy health and induce disease is beyond a doubt. That it is greatly under the control of sanitary law is equally certain, and there are men now who have so studied and comprehended the nature of those laws, that they are able, practically as well as theoretically, to give that assistance and that advice which should render those conditions almost innocuous—in fact it should prevent them altogether."

Dr. Andrew Clark, after stating that he considered the Association "one of the most pressing needs of the present time," added:—"Furthermore I am convinced that if the Association can secure and retain the services of men with the scientific and practical knowledge possessed by Prof. Corfield, and will hold itself free from undertaking the execution of the works which it may suggest, superintend, and from time to time certify as sufficient, it will do important service to the public, and confer much and just credit upon all concerned."

Mr. Edwin Chadwick, the veteran sanitarian, said that "he constantly advised people, from his knowledge, 'Do not take that house unless you have it examined first If the drains are out of order do not take it till they are put right. That was exactly what this Association had to supply."

We are happy to state that the formation of the Association was decided upon, and the following gentlemen were appointed a committee to organise it:—George Aitchison, F.R.I.B.A.; Prof. W. H. Corfield, M.A., M.D; Prof F de Chaumont, M D, F.R.S., Mark H Judge, Prof T. Hayter Lewis, F S A, H Rutherford Barrister-at-Law, with Prof Corfield as Chief Sanitary Officer, and Mr Judge as Surveyor.

It is surely as necessary to be assured against preventible diseases as it is to be assured against fire, and we see from the preliminary prospectus issued that it is intended to give persons who place their houses on the Assurance Register certificates that their houses are in a satisfactory sanitary condition, and to endorse such certificates from time to time; this latter point is of great importance, as it is only by regular inspection at stated intervals that it is possible to ascertain that all continues to work satisfactorily.

A very important feature is also the proposal to examine and report on the plans of new houses, for there is at present absolutely no control exerted over the sanitary arrangements of new houses in the metropolis

We have given such prominence to this matter because we believe that the Association will supply a widely-felt want, and will do good not only directly but indirectly too; thus wise builders will take care to have their houses supervised and certified, and will reap their reward in increased facilities for letting, architects will submit their plans for criticism and suggestion; and so the public will in many ways reap a lasting benefit. In this country few new things succeed unless public opinion is ripe for them. We are slow to adopt new ideas; but we have now learnt the importance of preventing disease, we believe that much of our health depends on the perfection of the drainage arrangements of our houses, and we are ready to place them in the hands of an association in which we can have confidence

HINCKS'S "BRITISH MARINE POLYZOA"

A History of the British Marine Polyzoa. By Thomas Hincks, B A, F R S (London J. Van Voorst, 1880)

THE value to science of Mr Van Voorst's splendid series of volumes descriptive of the Natural History of the British Islands is scarcely to be overrated. The monographs are all the work of most eminent naturalists, in whom perfect confidence may be placed, and they are sumptuously printed and illustrated with abundance of excellent plates and woodcuts. The thanks of naturalists generally are certainly due to Mr Van Voorst. The present work is fully equal in merit to its predecessors, it consists of two volumes—one of 600 pages of text, the other containing eighty-three lithographic plates. Mr. Hincks, whose industry is indefatigable, has already contributed to Mr Van Voorst's series the well-known excellent monograph on the Hydroid Zoophytes. The labour involved in the production of a monograph such as that now under consideration is very great. All the 235 species occurring on the British coast are figured, with one or two exceptions in cases where specimens do not exist for the purpose. All the figures have been drawn by the author himself and beautifully lithographed by Mr. Hollick. Further figures are added taken from various monographs where such are necessary for the elucidation of the subject.

The work commences with an introduction, in which the author, after expressing his obligation to Mr Busk,

Mr. Norman, Mr. Peach, Dr. McIntosh, Prof. Ray Lankester, and others who have given him valuable aid in his work, gives an account of the structure of the Polyzoa generally, with some details concerning their development, life-history, and distribution. Several pages are devoted to the question of the name of the class concerning which it seems almost hopeless that any unanimity amongst naturalists will be attained. The author adopts J. V. Thompson's term Polyzoa on the ground of priority, and we hope it may prevail in this country, although it is scarcely probable that Continental zoologists will, as the author trusts, "reconsider the grounds on which they have hitherto given their adhesion to Ehrenberg," and give up the term Bryozoa (*Moosthierchen*).

Several pages are devoted to the question of the nature of the "brown bodies," which the author, following Prof. F. A. Smith and from his own extended observations, formerly considered to be essentially concerned in the production of new polypides by germination. He now admits that the evidence at present tallies better with the residuary theory of Nitsche and Joliet, who, as is well known, regard the bodies as merely remains of decayed polypides, but thinks that further investigation on the matter is yet required. An interesting series of woodcuts are given illustrating, as shown in a series of different species, the development of the avicularium from the first rudimentary stages, hardly distinguishable from the ordinary zoœcium, up to its most highly specialised bird's head-like form. Most readers are familiar with Mr. Darwin's account of his experiments on the avicularia of Polyozoa made during the voyage of the *Beagle* and published in his Journal. The author after citing these, and those of Mr. Busk and others, expresses himself as inclined to regard the avicularia as "charged with an offensive rather than alimentary function," believing that their vigorous movements and the snapping of their formidable jaws may drive away loafing annelids and other enemies.

Some short account of the embryonic development of the Polyozoa is given, and is illustrated by a coloured plate of larvæ taken from the splendid monograph on the subject by Dr. J. Barrois of Lille. In the matter of classification the author follows Ray Lankester as far as the main sub-classes are concerned, dividing the class according to the characters of the lophophore into the Holobranchiata, or those which have the tentacles in a continuous series, and the Pterobranchiata, in which the lophopore is broken into two distinct arms like those of Brachiopods. The Pterobranchiata include only a single genus, the remarkable Rhabdopleura of Allman. The Holobranchiata are divided, after Nitsche, into the Ectoprocta, in which the anal orifice lies without the lophophore, and the Entoprocta, in which the orifice lies within it. The latter group includes the genera Pedicellina and Loxosoma only, whilst the main mass of the existing Polyzoa come under the Ectoprocta, the marine forms of which form a single order, Gymnolæmata of Allman, which order is divided by the author according to Mr. Busk's well-known system into the sub-orders Cheilostomata, Cyclostomata, and Ctenostomata. The generic terms adopted in the work are however in many instances different from those employed by Mr. Busk and other former authors, and many familiar species have changed their names, so that the student is somewhat confused. Thus the species hitherto ranged under the genus Leptalia are separated into sections and placed under the author's three genera, Mastigophora, Schizoporella, Schizotheca, and other genera.

As before stated, the number of British species of marine Polyzoa described in the work is 235. Of these 69 have as yet not been found elsewhere, but as the author adds, no inference as to their range can be drawn from this negative fact. For 28 species Shetland is the only British locality, 8 of these not being found elsewhere, whilst the remainder are Arctic forms, with the exception of two, one of which, *Cellaria johnsoni*, ranges as far south as Madeira, and is abundant in the Mediterranean. Some of the British species have an extraordinarily wide range. Thus *Cellaria fistulosa* occurs in the Mediterranean at Madeira, in South Africa, in Scandinavia and North America, in the Indian Ocean, and in Australia and New Zealand. And there are several similar instances of almost world-wide distribution, the species not being deep-sea forms, but such as flourish between tide-marks and in shallow water, though also found at greater depths. The author suggests as a possible explanation of the wideness of range of such species, in addition to migration along coast lines and in profound depths, the agency of currents, floating timber, and ships. There is a very close resemblance between the Polyzoan fauna of the south-west coasts of France and our own, whilst a small group of Polyzoa is common to our shores and those of South Africa, but these are also Mediterranean. The author expects that a flood of light will be thrown on the subject of the distribution of the Polyzoa by the results of the *Challenger* Expedition, when published. It is obvious that in treating of any branch of the marine fauna of a restricted area, such as the British Isles, it will be necessary to make some restriction as to depth in considering questions of distribution. Once the abyssal fauna is reached by the dredge the animals obtained have no longer any special connection with the shores off which they are obtained, but belong to the ocean bottom and are mostly cosmopolitan, or rather Oceanopolitan.

The cordial thanks of zoologists are certainly due to Mr. Hincks for having produced this most useful work. It will be valuable not only to the professed naturalist, but also an entertaining addition to the sea-side libraries of those who work occasionally with the microscope for recreation.

OUR BOOK SHELF

A Popular History of Science. By Rob. Routledge, B.Sc. (London: George Routledge and Sons, 1881.)

In looking through many of the works on popular science one is inclined to exclaim, "Oh, monstrous! but one halfpennyworth of bread to this intolerable deal of sack." Mr. Routledge's recent volume is fortunately an exception to this rule, for in it we find a clear and concise statement of the development of the main branches of physical science given in a readable form with such an amount of biographical notices as to impart a human interest to the tale. Extracts, too, from the writings of the great workers in science have been judiciously interspersed throughout the text, thus bringing the student into direct communication with the master mind. Numerous illus-

trations accompany the description; some of these are original, and others taken from the French, and none the worse for that. Most of them are well executed, but intimate friends might possibly find some fault with the likenesses of living men of science. Of course it is an easy as it would be a thankless task to point out sins of omission, and perhaps also of commission, in a book like the one under notice. Such works must not be looked upon with the eye of microscopic criticism. If the general direction which the author takes is the right one, if he does not make his task easy by glossing over all the points of difficulty, but puts his case clearly and fairly forward, he may well be excused if he omits matters which one or other of his readers may deem necessary These conditions Mr. Routledge, as it seems to us, has satisfactorily fulfilled. We can therefore cordially recommend this "Popular History of Science," believing that it will exert a healthy influence on all who read it, and may be a powerful means of spreading the love of science amongst the rising generation. H E. R.

Class-Book of Elementary Mechanics, adapted to the Requirements of the New Code. Part I *Matter*. By Wm. Hewitt, B Sc, Science Demonstrator for the Liverpool School Board. (London George Philip and Son, 1880)

MR. HEWITT has probably had a better chance than any other teacher of knowing by experience the working of the meagre science-subjects of the new educational code The defects of that code, and particularly of its directions as to the subject of mechanics, are very great, nevertheless the little book which Mr Hewitt has produced shows how, in spite of the disadvantageous system under which he works, a really good teacher will succeed in working up the subject for his pupils. We have seldom met with a *really* elementary book which at once combined to so great a degree simplicity of language, accuracy of description, and sound science Mr. Hewitt states as his experience that the main difficulty has hitherto been to get the children to express in anything like precise language the ideas suggested to their minds by the simple experiments shown them. He therefore intended this little work to serve as a lesson-book to be read by the pupils in the intervals between the experimental lessons This first part covers the ground prescribed by Schedule IV for the first stage. A second part, dealing with "Force," is in preparation, and will embrace the subjects of the second and third stages We hope Mr. Hewitt's second part will prove as satisfactory as is his first instalment. His aims are limited, indeed, by the requirements of the Code, but within those narrow limits his success is great.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Sir Wyville Thomson and Natural Selection

I HAVE at least great reason to be thankful that my stupidity has not prevented me from thoroughly enjoying the teachings of Mr. Darwin and Mr Wallace, which I confess to having regarded as chiefly masterly and charming "studies in variation," for the last twenty years.

The title of the epoch marking book which came of age last month was, however, "The Origin of Species by Means of Natural Selection." Mr. Darwin, as I am well aware, has put forward this mode of the origin of species as a part only of a hypothesis which is universally looked upon as a supreme effort of genius.

It seemed to me, rightly or wrongly, that the fauna of the enormous area forming the abyssal region existed under conditions which held out the hope that it might throw some light upon a question which appears to underlie the whole matter, and which is still unanswered Are physiological species the result of the gradual modification of pre-existing species by natural selection, *or by any similar process*, or are they due to the action of a law as yet utterly unknown, by which the long chain of organisms rolls off in a series of definite links?

I fear I scarcely follow Mr Darwin's illustration If one were to pay his first visit to a breeder's, and be shown a flock of Leicesters, never having seen or heard of a sheep before, he would see nothing but a flock of sheep, and would certainly, without justly incurring the contumely of the breeder, be entitled to set them down merely as a group of animals of the same *species*, that is to say, animals fertile with one another and producing fertile progeny. He would judge so from their common resemblance, and without previous observation or information I do not see how he could know more about them But give him an opportunity of comparing the results of breeding throughout a long period of time, or of observing the process of breeding over half the world, which comes to much the same thing, the breeder might then have cause to rail if he had not picked up the stages of the process.

The close examination of the newer tertiaries and the careful analysis of the fauna of the deep sea seem to me fairly to represent these two methods, both of these promise to yield a mass of information in regard to the course of evolution, but as to the *mode* of the origin of species both seem as yet equally silent

I will ask you in a week or two for space for a short paper on "The Abyssal Fauna in Relation to the Origin of Species"

C. WYVILLE THOMSON

Rapidity of Growth in Corals

THROUGH the kindness of M. Parrayon, captain of the French man-of war *Dayot*, I have received a large coral of the fungia tribe, which was yesterday found attached to the bottom of his ship as the copper was being cleaned by native divers The following is the history of the occurrence. The *Dayot* entered the tropical waters of the South Pacific about seven months ago, coming directly from the coast of Chile. She visited some of the islands, but made no long stay in harbour until she reached Mauga Reva (Gambia Islands), where she remained for two months in the still waters of a coral basin. On entering the basin she touched the reef slightly, and without sustaining any damage. From Mauga Reva she sailed to Tahiti, where she now lies

Several specimens of living coral were found attached to the copper sheathing, that which I have received being the largest It is discoidal in shape, with its upper and under surfaces respectively convex and concave, and near the centre of the under surface there is a scar, where the pedicle by which it was attached to the copper sheathing was broken through. The disk measures 9 inches in diameter, and the weight of the specimen (now half dry) is 2 lb. 14 oz On examining the under surface another disk $3\frac{1}{4}$ inches in diameter is seen partly imbedded in the more recent coral growth Of this old disk about one-sixth part is dead and uncovered by new coral, and is stained of a deep blue colour from contact with the copper, while the outline of the rest of this old disk is plainly discernible, although partially covered in by plates of new coral

My impression is that on touching the reef at Mauga Reva nine weeks ago a young fungia was jammed against the copper, became attached, and subsequently grew to its present dimensions.

The case affords an interesting illustration of the rapidity of the growth of coral in these waters. R. W COPPINGER

Tahiti, August 13

Geological Climates

SINCE contributing the chapter in the history of the Coniferæ upon which Prof. Haughton remarks, I have seen *Araucaria Cunninghami* growing in gardens round Funchal, and my belief in the specific identity of the Bournemouth Eocene plant is further strengthened; yet still, as only foliage is known in the fossil, I should hardly be prepared to contest upon that alone a question of climate, however minute the resemblance. But even with the most undisputed identity there are so many possibilities

of error in arguing from a single species, that little importance should be attached to conclusions drawn from it.

Assuming them however to be specifically identical, as I myself believe them to be, and to have required precisely the same temperature, I think Prof. Haughton's case is not quite so strong as he believes. The present mean winter temperature of Bournemouth in lat 50° 43′ is 37° 4′, but the physical surroundings of Bournemouth are not now such as conduce to luxuriant forest growth, even if its temperature sufficed, and the conditions there in the Eocene time more probably assimilated to those of the south-west coasts of Ireland at the present day.

Now the mean of the coldest month at Valentia, lat 51° 44′, is 44°, and it may be fairly assumed that if Valentia were a degree farther south, corresponding to Bournemouth, the temperature would be one degree higher, and if sheltered by mountains from all the northerly winds as Glengariff is, the mean might possibly be raised to 46°. Thus but 11° are required to reach the minimum of 57° supposed to be required by his Araucaria Again, although the Moreton Bay Pine does not appear to support a less mean annual temperature than 67° to 70° between the Clarence and the Bellingen, which are its southern limits in Australia, it flourishes and ripens seeds in Madeira in a mean of 64° 96′, and although I have only noticed it in two gardens near the sea-level, I think it has only been excluded from others higher up the mountains in favour of the far more striking *Araucaria excelsa* Moreover from its present restricted area it appears to be a declining type, which may, when more widely distributed, and possibly in presence of fewer competing species in remote Eocene time, have sustained greater extremes of climate

Taking the species, however, as it exists, and apart from any such possibilities, uniformitarians have, it seems to me, but to account for an increase of 14° to 15°, that is if Bournemouth were near its northern limit, as seems probable from its having grown at or near the sea-level.

Supposing, as all evidence tends to prove, that Northern Europe and America were connected by continuous land in Eocene time, would not the mere fact of shutting off the Arctic Seas cause a general and perhaps sufficient rise of temperature? In N. lat. 70° Prince Albert Land has a mean of only 5° Fahr, and Lapland one of 32°, a difference of no less than 27°, caused solely by the presence of an Arctic ice-laden current. The general cooling effect of incessant oceanic circulation between the North Pole and the Tropics is, I think, scarcely taken into sufficient account, and although it may be contended that conversely the northerly flow of the Gulf Stream mitigates climate, I think that its action in Europe is chiefly in fending off the ice-laden currents from our coasts, the limit of trees penetrating quite as far north in Siberia away from the coast as at the North Cape, where they are under its influence J. STARKIE GARDNER

Order Zeuglodontia, Owen

IN August 1848 H M.S. *Dædalus* encountered off St Helena a marine animal, of which a representation appeared in the *Illustrated News* of the latter part of that year. It is thirty-two years since I saw this figure, but I recollect that it was one of a blunt-nosed animal with a neck carried about four feet above the water, which was so long as to present the appearance of a serpent, and I remember that Prof Owen, in combating at the time the idea that this was a sea-serpent, pointed out that the position of the gape in relation to the eye, as shown in the figure in the *Illustrated News*, was that of a mammal, and not that of a reptile, in consequence of which he argued that the animal seen was probably only a leonine seal, whose track through the water gave an illusory impression of great length This idea, however, seemed to me untenable in the face of the representation in the *Illustrated News*, but it was obvious that to afford the buoyancy necessary for the support above the water of so long a neck (estimated on that occasion as sixty feet, though only the part near the head was actually out of the water), the submerged portion of the animal could not have had the shape of a serpent.

Two or three years after this, on reading the description of *Zeuglodon cetoides*, from the Tertiary (probably Upper Eocene) formations of Alabama, it struck me that the animal seen from the *Dædalus* may have been a descendant of the order to which *Zeuglodon* belonged; and I have ever since watched with interest for reports of the "great sea-serpent."

Three years ago the following appeared in the newspapers.—

"Borough of Liverpool, in the County Palatine of Lancaster to wit.

"We the undersigned, captain, officers, and crew of the barque *Pauline* (of London) of Liverpool, in the county of Lancaster, in the United Kingdom of Great Britain and Ireland, do solemnly and sincerely declare that on July 8, 1875, in lat. 5°3′ S., long 35° W, we observed three large sperm-whales, and one of them was gripped round the body with two turns of what appeared to be a huge serpent The head and tail appeared to have a length beyond the coils of about 30 feet, and its girth 8 or 9 feet. The serpent whirled its victim round and round for about fifteen minutes, and then suddenly dragged the whale to the bottom head first

"GEORGE DREVAR, *Master*
"HORATIO THOMPSON
"JOHN HENDERSON LANDELLS
"OWEN BAKER
"WILLIAM LEWARN

"Again, on July 13, a similar serpent was seen about 200 yards off, shooting itself along the surface, head and neck being out of the water several feet This was seen only by the captain and one ordinary seaman, whose signatures are affixed.

"GEORGE DREVAR, *Master*."

"A few moments after it was seen elevated some sixty feet perpendicularly in the air by the chief officer and the following able seamen, whose signatures are also affixed—

"HORATIO THOMPSON
"WILLIAM LEWARN

"And we make this solemn declaration, &c.

"Severally declared and subscribed at Liverpool aforesaid, the 10th day of January, 1877, before

"T S. RAFFLES, J.P. for Liverpool."

The locality here specified was about thirty miles off the northern coast of Brazil

In this account I thought that I recognised the grip of the whale by the long neck of the attacking animal, the appearance being confounded into the double coil of a serpent by the distance and motion of the objects; but in face of the general ridicule which has been attached to this subject, and being without any assurance that the declaration so purporting to be made was genuine, I did not venture to ventilate my long-cherished idea. A relative of mine, however, just returned from India, chancing to say that two of the officers of the steamer in which she went out had on the previous voyage witnessed an immense animal rear its neck thirty feet out of the water, and that a sketch of the object had been instantly made, and on reaching port sent to the *Graphic*, I obtained the number of that paper for July 19, 1879, and I inclose a tracing of the figures in it, which are accompanied by the following statement in the *Graphic* —

"The accompanying engraving is a *fac-simile* of a sketch sent to us by Capt. Davison, of the steamship *Kiushiu maru*, and is inserted as a specimen of the curious drawings which are frequently forwarded to us for insertion in the pages of this journal Capt. Davison's statement, which is countersigned by his chief officer, Mr. McKechnie, is as follows —'Saturday, April 5, at 11.15 a m, Cape Satano distant about nine miles, the chief officer and myself observed a whale jump clear out of the sea, about a quarter of a mile away. Shortly after it leaped out again, when I saw that there was something attached to it. Got glasses, and on the next leap distinctly saw something holding on to the belly of the whale The latter gave one more spring clear of the water, and myself and chief then observed what appeared to be a large creature of the snake species rear itself about thirty feet out of the water It appeared to be about the thickness of a junk's mast, and after standing about ten seconds in an erect position, it descended into the water, the upper end going first. With my glasses I made out the colour of the beast to resemble that of a pilot fish.'"

As I have not been able to find any description of the skeleton of the *Zeuglodon*, I venture to draw attention to the subject through your columns, in the hope that among your many readers in America this letter may attract the notice of some one who will tell us whether what is known of the osseous structure of *Zeuglodon cetoides* is or is not consistent with the representation in the *Graphic*. The remains of this cetacean, supposed to be extinct, indicate, according to Sir Charles Lyell, that it was at least seventy

feet in length,[1] while its great double-fanged but knife-edged molars show that it was carnivorous; and as we are not so far removed from the period of the Alabama Tertiaries as to render it improbable that members of what must once have been a great order of carnivorous cetacea, totally distinct from the orders of cetacea hitherto known as living, may still survive, I have braved the ridicule attaching to this subject so far as to invite attention to it

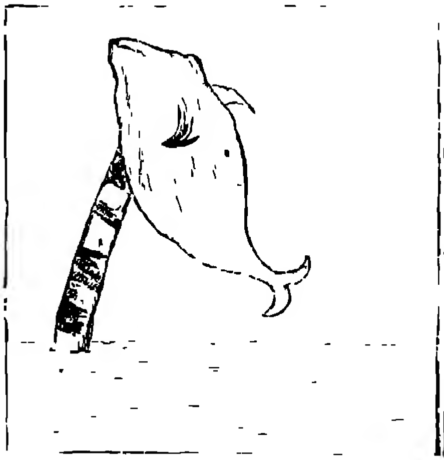
The second of the two figures in the *Graphic* shows the long-necked animal to possess the cetacean tail, and its head there seems to have been turned from the observer, so that the under-side of it only is presented. The first figure shows that the whale had been seized on its flank by the powerful bite of its aggressor, and that to escape from this it had thrown itself out of the water. Having succeeded in this object the second figure shows the aggressor rearing its head and neck out of the water to discover the direction which its prey had taken, in order that it might follow it up, and so far from the charge of curious drawing made by the editor of the *Graphic* being justified, the representation of the whale can be at once recognised as fairly correct, while that of the tail of the unknown animal (which probably prompted this charge), so far from being curious, forms an important piece of evidence as showing the animal in question to be cetacean.

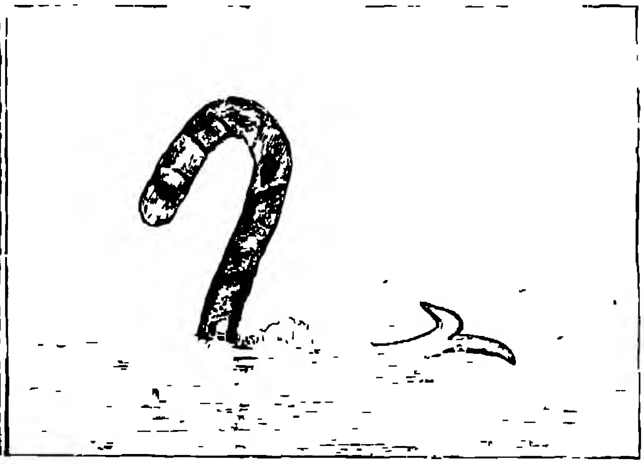
SEARLES V WOOD, Jun

Martlesham, near Woodbridge, September 27

P S —Since sending to you the above I have again seen my relative, and find that the cut in the *Graphic* of July 19, 1879, is not that of the instance observed from the steamer in which she came home, which was the *City of Washington*, but of a separate instance which occurred to another ship I have not been able yet to procure the *Graphic* containing the figure of the animal seen from the *City of Washington*, but she tells me that it was pasted up in the saloon, and represented only the head and long neck of the animal, which was raised to a great height out of the water, and near to the ship, and had been drawn for the *Graphic* by a lady passenger immediately after the occurrence These repeated and independent notices of the same long-necked animal are, however, the more confirmatory of its existence.

I find that Prof. Owen, in his article on Palæontology in the *Encyclopædia Britannica* (vol. xvii p 166), in giving a description of *Zeuglodon cetoides*, says that "the skull is very long and narrow *and the nostril single*," that Dr Harlan obtained the teeth on which, correcting Harlan's reptilian reference of them, he founded the order *Zeuglodontia*, from the Miocene of Malta, and that the teeth discovered by Grateloup in the Miocene beds of the Gironde and Herault, and ascribed by him also to a reptile under the name of *Squalodon*, are those of a smaller species of *Zeuglodon* The remains of *Squalodon*, along with those of the shark with huge teeth, *Carcharodon megalodon*, and of numerous cetaceans assigned to orders all still living, and of which some, such as *Delphinus*, belong to living genera, occur in the "Sables inférieurs" of Antwerp, which, though long called Miocene, are by M Vandenbroeck regarded as older Pliocene, and as the base of that series of deposits of which the





middle and upper divisions are respectively represented by the Coralline and Red Crags of England, and with these "Sables inférieurs" the so-called Miocene of Malta, in which *Zeuglodon* is associated with *Carcharodon*, is probably coeval. Dr. Gibbes (*Jour Acad. Nat. Sc.*, 2d. ser, vol. i. p 143), figures and describes teeth of the Antwerp species of *Carcharodon* from both the Eocene of South Carolina and the Miocene of Alabama These various references bring the *Zeuglodonts*, with their *Carcharodon* associates, down to a late geological period, during which they co-existed with Delphinian prey; and of this prey the whale in the woodcut (which looks like a *Grampus*) seems an example

It is most likely that Bishop Pontoppidan, a copy of the English (1755) edition of whose work I possess, concocted his two figures (one of which is that of a huge snake undulating on the waves, and the other that of a serpent-like animal with pectoral flappers or fins, resting almost on the surface of the sea, with head and tail erect out of the water like the letter U, and spouting water or steam from its mouth *in a single column*), from accounts given him by Norwegian seamen, some of whom had seen the animal in the position in which it was observed from the *Dædalus*, and others in that in which it is represented in the cut as seen from the *Kiushiu-maru*; for in the long narrative which he gives of the descriptions received from observers at numerous times, some of these agree with the one, and some with the other, though both of the Bishop's figures represent only preposterous conceptions of his own

[The animal seen from the *Osborne*, and figured in the *Graphic* of June 30, 1877, as the "Sea-serpent," is quite a different thing from the one in question, and may have been a *manatee*]

[1] He observes in the third edition of his "Manual of Elementary Geology" (1851), p. 208, that he visited the spot where a vertebral column of this length belonging to *Zeuglodon* had been dug up.

Temperature of the Breath

THE interesting observation made by Dr. Dudgeon (NATURE, vol xxii. p. 241, and vol. xxiii. p. 10) to the effect that breathing on the bulb of a thermometer through several folds of flannel or silk raises the temperature of the instrument several degrees above that of the mouth and body, is easily verified There is no doubt about the accuracy of the observation, but the explanation of it offered by Dr. Dudgeon is not satisfactory He supposes that the heightened temperature is due to the expired air being hotter—not cooler, as is usually believed—than the mouth and body A simple experiment sufficed to show that this view was untenable A clinical thermometer was inserted in the cavity of the mouth, and the stem grasped by the teeth in such a way that the bulb lay free in the oral cavity Inspiration was carried on by the nostrils, and expiration was effected by gently forcing the breath between the loosely-closed lips and the stem of the instrument. The bulb was thus placed in the centre of the stream of expired air and kept free from contact with the tongue and cheeks. Experimenting in this way, I found, at the end of five, and also of ten, minutes that the thermometer marked 97·2°—the temperature under the tongue at the time being 98·4°.

Had the breath been hotter than the mouth the instrument could not have failed to register a higher temperature than 98·4°, but being really cooler, the instrument, of course, recorded a lower temperature.

What is then the true explanation of the phenomenon observed by Dr. Dudgeon? I believe that it is simply an example of the conversion of latent into sensible heat by the rapid condensation of aqueous vapour The organic fabrics which compose our clothing are all more or less hygroscopic—that is to say, they have the capacity of imbibing aqueous vapour and condensing it into the solid and liquid forms. The expired breath is heavily charged with aqueous vapour, and aqueous vapour, at the moment of condensation, liberates an enormous amount of latent heat, which thus becomes sensible to the thermometer. In this particular watery vapour exceeds far away all other gases.

The following experiments were made with a view of testing the correctness of this view. Two strips of flannel were prepared, each six inches long and an inch and a quarter wide The first strip was rolled, without any preliminary preparation, round the bulb of a clinical thermometer. The bulb, thus enveloped, was inserted between the closed lips, and the expired air was forced through the porous material for a period of five minutes. The thermometer rose to 104°. The instrument was then allowed to cool, and, after having been re-set, was again inserted between the lips, and breathed through for a second period of five minutes. This time the temperature only rose to 101° The experiment was repeated a third time for a similar period, but this time the thermometer did not rise above 98·6.

These results tallied exactly with the requirements of the condensation hypothesis. During the first period the fresh dry flannel absorbed and condensed the watery vapour passing through it with such rapidity that the liberated sensible heat was sufficient to raise the mercury several degrees above the temperature of the mouth. In the second period of five minutes the hygroscopic activity of the flannel had been greatly reduced by the previous absorption of aqueous vapour, and the thermometer only rose slightly. In the third period saturation had been approached, and the breath passed through the flannel almost without depositing any of its moisture, and accordingly the thermometer only indicated a temperature slightly higher than that of the mouth

The second strip of flannel was subjected to a little preliminary preparation. In order to increase its hygroscopic activity it was thoroughly dried (superexsiccated) by holding it for a few minutes before the fire When it had cooled down to the temperature of the room it was wrapped round the bulb of the thermometer, and the experiment was proceeded with as before The result surprised me *In one minute* the mercury had risen not only to the top of the scale (112° F), but had filled the little bulb above it, that is to say, it had risen to at least 115° F When the instrument had cooled it was reset, and inserted again between the lips and breathed through for three minutes. At the end of this time the scale marked 106° F. After the instrument had been cooled and reset the experiment was repeated a third time, and the temperature only reached 102° after breathing through the envelope for four minutes. A fourth trial of four minutes only produced a record of 98 4° Here again the development of heat steadily declined as the flannel became less hygroscopic

It is probable that, with the superexsiccated flannel the first portions of aqueous vapour condensed at the beginning of the experiment pass at once from the gaseous into the solid form, and constitute that portion of water which is incorporated in intimate union with all organic tissues This accounts for the extreme rapidity of the development of heat at the commencement of the experiment. I found that even a single long expiration through the freshly-warmed flannel raised the mercury to 110° F.

Dr. Dudgeon's observation will not necessitate a revision of our conclusions respecting the temperature of the breath, but he has supplied us with an exceedingly elegant and easy way of demonstrating the liberation of sensible heat which takes place during the passage of water from the gaseous into the solid and liquid state.

WM. ROBERTS

Manchester, November 10

Height of the Aurora

IN NATURE, vol. xxii. p. 291, is inserted a letter of Mr. T. Rand Capron, on the determination of the height of auroræ, wherein I read: "It is unfortunate that simultaneous observations of the auroral corona are almost entirely wanting. I . . . would be glad if any particulars could now be furnished me."

Having treated the subject of the auroræ and their properties in an ample manner in my "Théorie cosmique de l'Aurore polaire" (*Memorie della Società degli Spettroscopisti Italiani*, 1878, vol vii), wherein I have adduced proofs of the thesis that *The corona is an optical illusion, due to the laws of celestial perspective*, I was astonished to find the alleged words used by so great an authority. That "simultaneous observations" of the auroral corona will be ever without any result, as far as its height above the earth is concerned, follows already from the known property, that the corona always shows itself in the direction of the *local* magnetic total force (given by the inclination needle).

Regretting that such a well-established fact seems not generally known, I take the liberty to refer Mr. Rand Capron to the chapter of my treatise, "Dans quelle Région de l'Atmosphère terrestre se trouvent les Rayons de l'Aurore polaire, et est-ce que la Couronne est une Chose réelle?" and will repeat here that very beautiful determinations of the height of streamers and beams were obtained by Prof. Heis and Dr. Flogel, and by Prof. Galle in Germany, showing a height of the phenomenon from 20 to 100 miles (of 15 in 1 degree). These results are published in the *Zeitschrift der oesterr Gesellsch f. Meteor* vii p 73.

I regret to have found no earlier opportunity of answering the request of Mr Rand Capron, but think that this letter may still have some interest, notwithstanding the valuable article by Mr. Plummer in NATURE, vol. xxii p 362

Groningen (Netherlands), H. T. H GRONEMAN

November 10

Fascination

As a contribution to this subject, at least of new material if of no decisive evidence in support of any existing theory, I offer the conclusions which Malachi Foot, Member of the College of Physicians and Surgeons, N Y, reached in 1807 relative to this matter A short memoir of his which I recently met was published in the *Medical Repository* for that year, entitled "An Examination of Dr. Hugh Williamson's Memoir on Fascination, to which is subjoined a New Theory of that Phenomenon," and is striking both in matter and conception

The author, after displaying some temper over Dr. Williamson's willingness to attribute the well-accredited effects of snake-charming to terror, producing in the victim a condition which he (Dr. Williamson) terms "dementation," and "wherein extreme fear stupefies the mind and deprives him of the understanding," produces his own explanation. Although he acknowledges the paralysing effects of fright, and instances quadrupeds falling lifeless from the effect of fear, deer stricken motionless by the light of a torch, &c., yet he inveighs against the false reasoning which discovers in these cases of arrested volition any analogy to the phenomena of so-called fascination. Our author, evidently of no superstitious habit, distinctly admits the fact that the snake repeatedly captures prey by a method seemingly so occult as to merit the characterisation of fascination, and develops his theory in the light of that very thought

He ascribes to the primary sensations of animals, in them unmodified by reflection as to their source or character, complete efficacy to awaken emotions of pleasure of an intensity to us quite incommensurate with the apparent causes which evoked them—emotions so powerful as to absorb all other secondary feeling, enfolding the animal in a delightful but numbing trance, whose stages advance from attention through ecstasy to anæsthesia. And he finds in the eye a sensory centre which most expansively responds to all outward stimuli. This much premised, he applies it to the case in hand. The snake, fixing its glittering eyes with hungry expectancy upon its victim, at the same time throws its body into graceful curves and raises its tail, undulating with a soft and inviting motion (Foot insists upon the almost invariable accompaniment of motion as auxiliary in attracting and pleasing the prey) The bird's eye, once caught, becomes ensnared in the endless succession of contortions, and it draws near, dominated by simple delight.

As Foot expresses it, "the pleasurable movements of the organs of vision stimulate to approach and excite an eager desire to embrace." *Reverie oculorum* ensues, and the bird flutters helpless to the ground. Foot speaks of having seen a cat succeed in similarly charming birds by wreathing the body and waving the tail, He might have confounded this with the

ordinary nervous concentration of attention common to the Felidæ before "pouncing." He speaks of larks being attracted in the South of France by means of an octagonal box holding a mirror mounted on a pivot which is turned by the wind. The reflected rays of sunlight dazzle and delight the birds, and they approach near enough to be caught by a spring net. The preliminary phase, that of attention, wherein curiosity perhaps predominates, is illustrated in the known trick of a fox amusing ducks by rolling itself down a bank, as also in the perilous interest excited in a loon by a handkerchief waved by an unseen hand. Many must have experienced, on looking over very high galleries upon floors beneath, or over sheer precipices, an almost uncontrollable impulse to throw themselves headlong down. Can this feeling be described as akin to "fascination"?

L. P. GRATACAP

Amer. Mus. Nat. Hist., N. Y., October 28

A. PERCY SMITH.—The little centipede is *Geophilus electricus*, well known to be occasionally luminous.

HOMAGE TO MR. DARWIN

ON Wednesday, November 3, a deputation from the Yorkshire Naturalists' Union waited upon Mr. Darwin at his residence, Down, Beckenham, Kent, for the purpose of presenting him with an address expressive of admiration for his long devotion to scientific research, and appreciation of the great and important results to which his investigations have led. Prof. Williamson, F.R.S., of the Owens College, Manchester, who is the president of the Union for the current year, was prevented from accompanying the deputation by the pressure of his professorial duties. The deputation arrived at Mr. Darwin's residence about 1 p.m., and was received in a most hearty manner by the great naturalist himself, Mrs. Darwin, and other members of the family. The members of the deputation were introduced individually to Mr. Darwin by Dr. Sorby, vice-president of the Union, and then the interesting ceremony of the presentation of the address was at once proceeded with. After a few words on the work of the Union by Dr. Sorby, the address was read by Mr. Thomas Hick, B.A., B.Sc., and formally presented to Mr. Darwin by Dr. Sorby. Replying to the address, Mr. Darwin assured the deputation of his deep sense of the honour the Yorkshire Naturalists' Union had conferred upon him on that occasion, and only regretted that he had not done something more deserving of such an honour. He had no idea previously that there was so strong a body of working naturalists in Yorkshire, but was pleased to learn that such was the fact, and to find from the *Transactions* that had been forwarded to him that they were doing useful work. Coming from such a body, the address was all the more gratifying to him, though he still feared he hardly merited the good things that had been said of him. The address which had been presented to him he and his family would for ever treasure and preserve, and he desired to express his warmest thanks, both to the deputation and those whom they represented, for it, and for the kind and considerate manner in which everything connected with it had been arranged. Subsequently the deputation were entertained at luncheon, and having spent a short time in familiar conversation with their hospitable host and his family, took their departure amid mutual expressions of kindness and regard.

The following is the text of the Address, which is dated August last:—

To Charles Darwin, LL.D., M.A., F.R.S., &c., &c.

SIR,—The Council and Members of the Yorkshire Naturalists' Union, all of whom, with scarcely an exception, are working students of one or more of the various branches of natural history, desire to express to you in a most respectful manner, and yet with the greatest cordiality, their admiration of your life-long devotion to original scientific research and their high appreciation of the almost unparalleled success of the investigations by which you have contributed so largely to the modern development and progress of biological science.

More especially do they desire to congratulate you on the fact that your great work on the Origin of Species will come of age at an early date, and that your life has been spared long enough to enable you to see the leading principles therein enunciated accepted by most of the eminent naturalists of the day. On the conspicuous merits of that and of your other published works they need not dwell, as those merits have been recognised and admitted even by those who have dissented most strongly from the conclusions at which you have arrived. They may nevertheless be permitted to remind you that your writings have been instrumental in giving an impetus to biological and palæontological inquiries which has no precedent in the history of science, except perhaps in that which followed the promulgation of the gravitation theory of Newton, and that which was due to the discovery of the circulation of the blood by Harvey.

One of the most important results of your long-continued labours, and one for which you will be remembered with honour and reverence as long as the human intellect exerts itself in the pursuit of natural knowledge, is the scientific basis you have given to the grand Doctrine of Evolution. Other naturalists, as you yourself have shown, had endeavoured to unravel the questions that had arisen respecting the origin, classification, and distribution of organic beings, and had even obtained faint glimpses of the transformation of specific forms. But it was left to you to show, almost to demonstration, that the variations which species of plants and animals exhibit, and in natural selection through the struggle for existence, we have causes at once natural, universal, and effective which of themselves are competent not only to explain the existence of the present races of living beings, but also to connect with them, and with one another, the long array of extinct forms with which the palæontologist has made us familiar.

Further, the Yorkshire Naturalists are anxious to place on record their firm conviction that in the care, the patience, and the scrupulous conscientiousness with which all your researches have been conducted, in the ingenuity of the experiments you have devised; and in the repeated verifications to which your results have been submitted by your own hands, you have furnished an example of the true method of biological inquiry that succeeding generations will deem it an honour to follow, and that cannot but lead to still further conquests in the domain of organic nature.

In presenting this small tribute of their high regard and esteem, the members of the Yorkshire Naturalists' Union cannot but hope and pray that many years of happiness and usefulness may yet remain to you, and that our Science and Literature may be still further enriched with the results of your researches.

(Signed) WILLIAM C. WILLIAMSON, F.R.S., President,
H. C. SORBY, LL.D., F.R.S., Vice-President,
GEORGE BROOK, ter. F.L.S., Secretary,
WM. DENISON ROEBUCK, Secretary,

and Eleven other representative Officials.

THE ATOMIC WEIGHT OF BERYLLIUM

FOR some time chemists have been doubtful what value to assign to the atomic weight of beryllium. Some years ago Prof. Emmerson Reynolds determined the specific heat of this metal to be 0·642; this number multiplied into 9·1 gave 5·8 as the atomic heat of beryllium, in other words it confirmed the generally accepted atomic weight. In 1878 Nilson and Pettersson re-determined the specific heat of beryllium, and found the number 0·408 for the temperature interval 0°–100°, hence these chemists concluded that the atomic weight of the metal must be increased by one-half ($13·6 \times 0·408 = 5·6$). If $Be = 9·1$ the oxide of beryllium is BeO, and the metal is placed in the magnesium group, but if $Be = 13·6$ the oxide is Be_2O_3, and the metal is placed in the aluminium group. But there is no place in Mendelejeff's classification of the elements according to the magnitude of their atomic weights for a metal with the atomic weight 13·6, forming an oxide M_2O_3, and exhibiting the properties of beryllium. The value of Mendelejeff's classification is however so great that chemists were not inclined to alter the atomic weight of beryllium except upon most cogent evidence.

Nilson and Pettersson have recently repeated their determination of the specific heat of beryllium, and find these numbers —

0°–50° spec. heat = 0·3973 0°–100° spec. heat = 0·4246,
0°–200° ,, = 0·475 0°–300° ,, = 0·5055.

If the atomic weight is taken as 13·6 then the atomic heat for the interval—

0°–50° = 5·46 0°–100° = 5·79 0°–200° = 6·48 0°–300° = 6·9,

hence the Swedish chemists conclude that the atomic weight of beryllium is 13·6

But in the last number of the *Berichte* of the German Chemical Society, Lothar Meyer has calculated, from Nilson and Pettersson's numbers, the true specific heat (*i.e.* the ratio between the quantity of heat required to raise unit weight of the given substance through 1°, starting from the given temperature, and the quantity of heat required to raise unit weight of standard substance through 1°, also starting from the given temperature) of beryllium for various temperatures his results are as follows:—

(γ = true specific heat at temperature t. $\Delta\gamma$ = value of increase of specific heat for 1°)

t		t		t	
23°	γ = 0·3973	73·2	γ = 0·4481	157°	γ = 0·5193
	$\Delta\gamma$ = 0·00101		$\Delta\gamma$ = 0·00085		$\Delta\gamma$ = 0·00063

t 256·8 γ = 0·5819.

Hence the atomic heats of beryllium are —

t	Be = 9·1	Be = 13·65
23°	3·62	5·43
73°	4·08	6·12
157°	4·73	7·10
257°	5·29	8·94

The value of $\Delta\gamma$ decreases as the temperature rises, in this respect beryllium resembles boron, carbon, and silicon. For other elements whose specific heats increase with increase of temperature the value of $\Delta\gamma$ also increases. Lothar Meyer therefore concludes that beryllium is analogous to boron, carbon, and silicon, in that its specific heat increases as temperature increases, and in that the value of this increase is less for 1° at high than at low temperatures Hence the atomic weight of beryllium is almost certainly 9·1, the oxide is BeO, and the metal finds its place in Mendelejeff's system of classification of the elements according to their atomic weights.

THE PHOTOPHONE

MANY readers of NATURE will doubtless be glad to know that Mr. Graham Bell's extraordinary experiments may be repeated on a small scale with very simple apparatus, no special appliances being required beyond the mirror transmitter and the selenium receiver, both of which may be easily constructed. I propose to give a short description of an arrangement which has in my hands been very successful

The mirror is made of the thin mica which is sold by opticians for covering *carte de visite* photographs. It is cut by scissors into a circle 2¼ inches in diameter, and silvered by the process for silvering glass specula The box in which it is mounted is an ordinary wood turned box 2½ inches in diameter A circular hole of about 2 inches diameter is cut in the lid, behind which the mirror is laid with the reflecting side outwards, a flat ring of vulcanised india-rubber of suitable size and thickness being placed behind the mirror, when the box is closed the ring should hold the mirror firmly in position. If the lid screws on, so much the better. At the bottom of the box is cut a hole, into which is glued one end of a flexible speaking-tube 18 inches long, having at its other end a wooden mouthpiece. It will be found convenient to attach a short wooden arm to the box in a direction perpendicular to its axis. By means of this arm the transmitter may be held in a clamp in any desired position.

This completes the transmitter as described by Mr. Bell. I have made a small addition which, though not essential, is a decided improvement. At the back of the mirror I cemented a disk of calico 1 inch in diameter, in the centre of which had been previously inserted a loop of silk half an inch long. A hole ⅛ inch diameter is bored perpendicularly in the side of the box at a point about ½ inch from the mirror end of it, and in this hole is inserted a piece of watch-spring 1⅛ inch long, with its flat sides parallel to the top and bottom of the box The spring is fixed into the hole with wooden plugs so that one end is flush with the outer surface of the box; the other end where it intersects the axis is bent into a shallow hook Into this hook is slipped the silken loop, and the tension of the spring draws the mirror into a slightly concave form, and seems to make it respond more perfectly to sound vibrations.

By far the most important part of the whole apparatus is the selenium "cell." After making some dozens of different forms, most of which were more or less sensitive, but none satisfactory, I tried the one now to be described, which turned out very successful. Take a slip of mica 2¼ inches long and ¾ inch broad, and beginning at ¼ inch from one end, wind round it in the form of a flat screw some No 40 copper wire. The pitch of the screw is 1/16 inch, that is, each wire on the two faces of the mica is 1/16 inch from its neighbours Continue winding up to ¼ inch from the other extremity, then fix the two ends of the wire by passing them through holes drilled in the mica Now take a second wire and carefully wind this on beside the other, thus forming a second screw, the threads of which are midway between those of the original one Fix this as before Great care must be taken that the two wires do not touch each other at any point: it will be well to make sure of this by testing with a galvanometer before proceeding further If a lathe is at hand, the tedious operation of winding may be very greatly facilitated. Turn a cylinder of hard wood 4½ inches long and 1 inch in diameter: cut this cylinder longitudinally into two equal parts, and between the two semi-cylinders thus formed place, sandwich-like, a slip of mica of equal breadth. Secure the ends with screws Smooth down the whole in the lathe, and when the edges of the mica are quite flush with the surface of the wood, cut upon the cylinder a screw of thirty-two threads to the inch. On removing the mica from the cylinder its two edges will be found to be beautifully and regularly notched Wind the first wire into alternate notches, and the second into the others The wire should be annealed to take away its springiness and make it lie flat, and the mica should be stout enough to bear tight winding without buckling.

For the succeeding operation a retort-stand at least 15 inches high is convenient. Fix one ring 15 inches above the foot, on a lower ring stand a medium-sized Bunsen burner On the top ring lay a flat sheet of brass 1/16 inch thick, and on the brass a piece of mica (to save waste selenium). Place the embryo cell on the mica, laying small weights on its two ends to keep it steady and bring it into closer contact. Having brought the Bunsen burner close under the brass, melt a few grains of vitreous selenium in a small spoon and let four or five drops fall upon different parts of the cell Spread the melted selenium evenly over the surface with a slip of mica, pressing it well between the wires. During this process the temperature must be carefully regulated by raising or depressing the burner If it is not high enough, the selenium will begin to crystallise, if too high, the selenium will gather up into drops, being apparently repelled from the surface of the cell. The temperature should in fact be just above the fusing point of crystalline selenium. When a smooth surface is obtained, quickly remove the cell with microscope forceps and let it cool. Its surface will now be smooth and lustrous.

The cell must next be annealed. And here my expe-

rience differs in a remarkable manner from that of Mr. Bell, as stated in his celebrated lecture. It is true that selenium may be rendered crystalline in "a few minutes," but in this condition I find it far less sensitive to light than after it has undergone a process of long heating and slow cooling. My method is as follows.—The brass plate being cool, lay the cell upon it again, and place the burner at its lowest possible point. The selenium will soon begin to crystallise, as evidenced by its surface assuming a dull leaden appearance. (If the crystallisation has not begun in five minutes, raise the burner an inch or two.) In from five to ten minutes the whole of the selenium should be crystallised. Then very gradually raise the burner until signs of fusion just begin to appear. This will probably take place when the flame is within 3 inches of the brass. Instantly remove the burner, and in about ten seconds re-crystallisation will occur. Now fix the burner $\frac{1}{2}$ inch below the point at which it was when fusion commenced, and let it remain for four hours, merely looking at it from time to time to ascertain that, owing to increase of gas pressure or other causes, the heat has not become too great. After four hours begin the cooling by lowering the burner an inch or two, and repeat this operation every ten or fifteen minutes, until the burner is at its lowest point. Then slightly lower the gas-flame at short intervals, until it is finally extinguished. When the brass plate is quite cool the cell may be removed.

I may mention that I first made a cell of this form, which I believe to be original, on October 28.[1] If the two wires were wound on a cylinder made of some suitable non-conductor (*e.g.* slate) with a double screw cut upon its surface, a cell might be formed which, it appears to me, would unite all the advantages of Mr. Bell's with far greater simplicity.

My experiments were made with the transmitter and selenium cell above described, a magic-lantern with a 4-inch condenser, the focussing lenses being removed, two plano-convex lenses obtained by separating a 3½-inch condenser, a "blow-through" lime-light, a battery of eleven cells (small Leclanché's answer well), and a pair of Bell telephones. It is essential that the bobbins of the latter be wound with finer wire than that generally used. Mine contain No. 40 (instead of 35 or 36), and I intend to try 42. Their diameter is also larger than usual—1$\frac{3}{4}$ inch.

The transmitter is clamped so that its axis is inclined at an angle of about 30° to that of the lantern condenser, the centre of the mirror being 7 or 8 inches from the centre of the condenser; and the position of the lime-light is so adjusted that the condensed rays may just cover the whole surface of the mirror.

The reflected beam is rendered as nearly parallel as possible by one of the plano-convex lenses (this can only be done approximately), while the other, placed a foot or two away, concentrates the light upon the selenium cell, forming an elliptical image of the mirror. The major axis of the ellipse should be parallel to the length of the cell, and the minor axis slightly longer than its width. A great deal depends upon the focussing, and the best results have been obtained when the image of the mirror was not quite sharp. The selenium cell is joined in circuit with the battery and the pair of telephones, the latter being for obvious reasons placed in a distant room. The arrangements are now complete, and a person listening with a telephone applied to each ear will, if everything is right, plainly hear words which are spoken into the transmitter. When I first made the experiment I was so much astonished at the distinctness of the reproduction that I believed that one of the battery connections must be defective, thus acting like a microphone. This was disproved by screening the mirror, when all sound instantly ceased.

Though the articulation is not perfect, it is far better than I had expected, judging from the accounts of the performances of the photophone in Paris. A leading article might not be altogether intelligible, but ordinary colloquial phrases are readily understood. The loudness of the reproduced speech varies in an unaccountable manner. Sometimes the voice is rendered almost as loudly as in an ordinary telephone; at other times, under apparently the same conditions, it is scarcely audible. Alternations from loudness to faintness, and *vice versâ*, frequently occur in a single sentence.

The distances across which the beam is carried have varied in my experiments from 1 foot (when the two plano-convex lenses were in actual contact) to rather more than 4 feet.[1] With a larger receiving lens this distance could be greatly extended, especially if the electric light were used.

For the "musical" effects produced by an interrupted beam I use a disk of zinc 1 foot in diameter, having eight radial slits cut in it, and mounted upon a vacuum tube rotator. The cell is placed 6 inches from the lantern condenser, and the disk made to rotate close before it. The sound produced is very loud, and can be heard when the telephones are at a distance of a foot or more from the ears.

It is very singular, that whereas I have been so successful in repeating Mr. Bell's more complex experiments, I have utterly failed in all attempts to produce sound by the simple incidence of an interrupted beam upon a thin diaphragm. I have experimented with disks of ebonite varying from $\frac{1}{64}$ to $\frac{1}{4}$ inch in thickness, and with several metals, and can only suppose that my source of light is not sufficiently powerful.

SHELFORD BIDWELL

[1] If a larger surface is desired two or more of these cells may be placed together side by side, the ends of the wires being properly connected. The width of $\frac{3}{4}$ inch for a single cell cannot be much exceeded, because the expansion produced by the heat necessary for melting the selenium would make the wires on a wider surface so loose as to touch each other.

[1] With a 5½-inch receiving lens the distance has been increased to upwards of 10 feet.

THE CHRONOGRAPH

MESSRS. E. DENT AND CO., of the Strand and Royal Exchange, London, have been for some time past at work upon three galvanic chronographs of unusual accuracy and power. They surpass in both respects, so far as we know, any similar instruments yet constructed, and we believe, therefore, some account of them will be interesting to our readers. They are destined respectively for the Royal Observatory of Brussels, for the Japanese Government, and for the Egyptian Government.

The advantages of the "chronographic" registration of the times of observations in observatories are not to be gainsaid. In the absence of any such arrangement an astronomer, whilst watching through his telescope, has to compute the time by counting up the clock-beats. More often than not he will find that no clock-beat exactly coincides with the instant of his observation. He must then reckon the difference—the fraction of the second elapsed—by judgment as best he is able. Skilled observers can reckon to tenths of seconds, but these are large and coarse amounts compared with what may be noted upon such chronographs as those we are referring to. In any case the astronomer must make a hurried memorandum of his results, otherwise he is liable to forget them.

The Astronomer-Royal was, we believe, the first to introduce a system of astronomical chronographic measurement into England, and he designed and had constructed at the Royal Observatory a large apparatus for the purpose. The reader must bear in mind that though differing in some respects both in their mechanism and the means employed, the chronographs we are going to describe are fundamentally the same as the Astronomer-Royal's.

C C (see Fig. 1) is a cylinder around which one thickness of paper is wrapped, and underneath it is a long screw W W. A wheel on the axis of C C gears into one mounted on W W; thus when the cylinder turns, the screw turns. W W is tapped through the lower portion of a carriage K (compare Fig. 2), and K rests on rails parallel with W W. When the screw W W turns, K cannot turn too, and is therefore propelled by the screw up or down the rails underneath the cylinder.

L is clockwork which drives the screw, and consequently the cylinder and carriage. The rapidity with which L moves is regulated by the pendulum P P. P P is a conical pendulum; that is, instead of oscillating, it swings round in the surface of a cone. P P is suspended by two pairs of springs S S, S S at right angles to each other.

Let us consider the actions of C C and K (see Fig. 2). K carries two prickers, one of which is placed in electrical communication with the Observatory standard clock. It

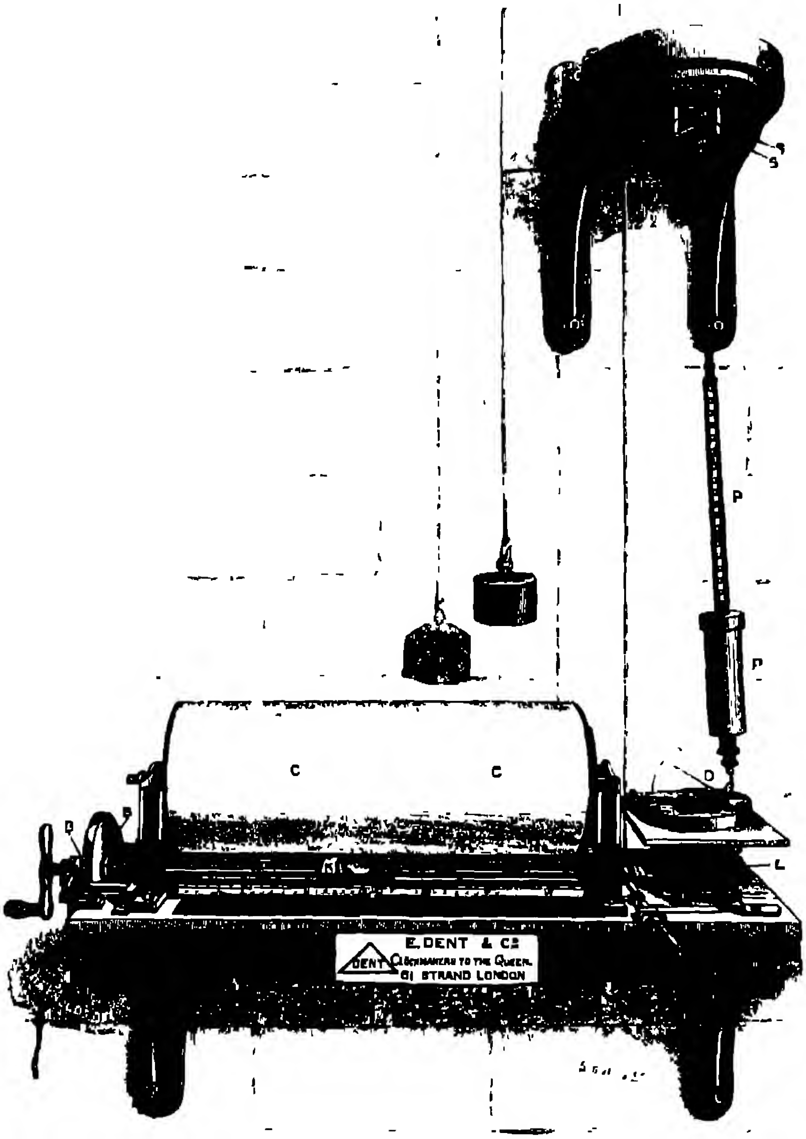


FIG. 1

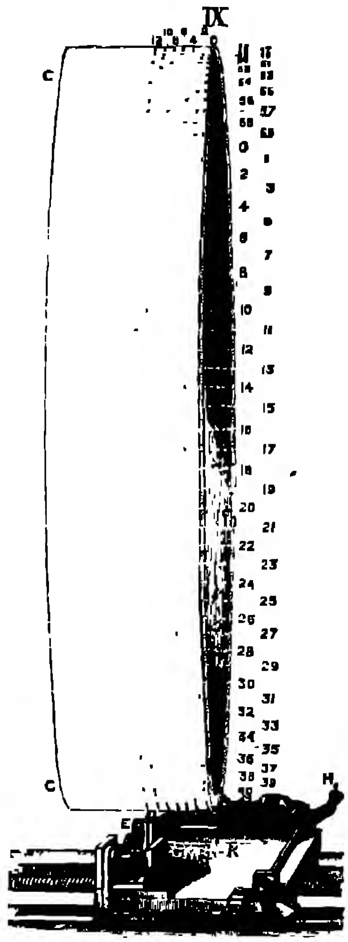


FIG. 2

is so arranged that at every beat of the standard clock (except the 60th second of each minute) the pricker shall rise and puncture the paper wrapped round the cylinder. Now suppose that whilst the clock keeps pricking, the cylinder is turning, and the carriage K moving to the left Then we shall get a succession of pricks marked off upon the cylinder in the form of a slightly inclined spiral, and the distance between each prick will represent one second. Every 60th prick (or second) being omitted, the occurrence of each minute is easily distinguished.

The carriage K carries another pricker alongside the clock-pricker—this is the observation-pricker. The observation-pricker is placed in electrical communication with any instrument in the observatory the astronomer may be going to use, and it is so arranged that the astronomer by merely pressing down a stud can cause the observation-pricker to rise and puncture the paper on the cylinder. This it will do somewhere alongside the spiral of clock-pricks. By reference to the latter the time of the observation can then be determined to the $\frac{1}{10}$th of a second.

Let us examine the pricks on the cylinder (Fig. 2). The spiral of the clock-pricks winds around the cylinder

from left to right. As the cylinder turns once in two minutes, there is between each prick and its fellow similarly positioned on the next spiral a difference in time of two minutes. As stated above, we note by the absence of the pricks the occurrence of the minutes. By reference to the figures placed (for explanation) along the top and side of the section of the cylinder, we see that the time of the highest prick on the left-hand spiral was 9h 12m 46s Following the course of the spiral down towards the

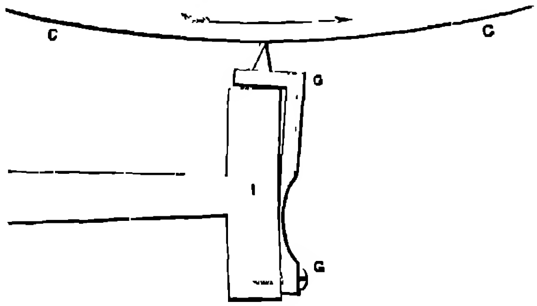


FIG 3

pricker which is tracing it, we first pass the blank line indicating the occurrence of the next minute, and then come to three observation-pricks at about the 8th and 9th seconds beyond it These in practice would be measured off and their values determined to the $\frac{1}{50}$th or $\frac{1}{100}$th of a second. There are other observation-pricks at the 22nd second, the 24th, and 25th, and there is a group of others at about the 40th.

When all the observations have been reckoned up the paper is put away, and it is not the least advantage of

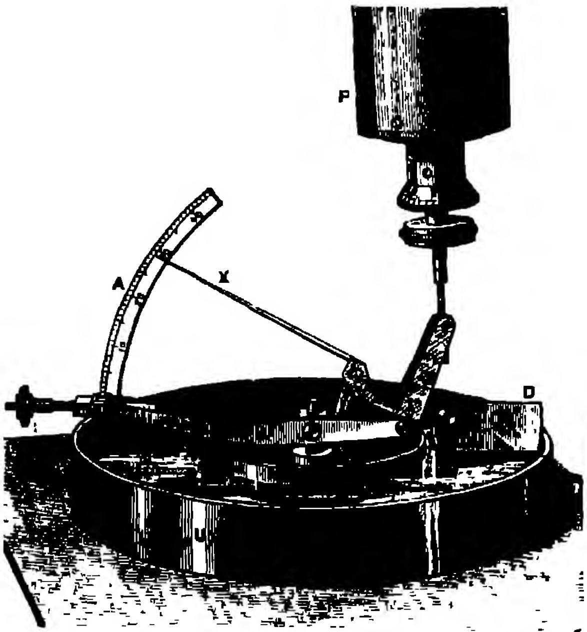


FIG. 4.

the "chronographic" method that in any case of doubt the original observation can be itself referred to years afterwards.

As the paper is moving whilst being punctured, the prickers have to be mounted on springs to enable them to yield a little. In Fig. 3 is a side view of the pricker, G G being the spring, and C C a portion of the cylinder.

There is no difficulty in reading off the observations after a little practice: but in order to facilitate the eye in following the sequence of the punctures—before the paper is used a continuous spiral line is ruled upon it which shall exactly correspond with their course This is done in the following way (see Fig. 1).—At T are two clutch-wheels, which connect the screw and cylinder with the clock-work L. By moving a lever near them the clock-work is thrown out of gear, and simultaneously the winch on the left is thrown into gear with the screw On the carriage K (see Fig. 2) is a little roller E, and by moving a handle this is sprung up against the paper on the cylinder The winch before referred to is now turned, the cylinder rapidly revolves, and the carriage quickly traverses the screw, the spiral line meanwhile being traced by the pressure of E upon the paper of the cylinder. To prevent damage to the prickers during the operation, the act of disengaging the clock-work breaks their electrical communication, and they can neither of them be raised until the clutch-work is restored. The cylinder moves very swiftly whilst the line is being traced, and were it brought to a standstill suddenly great damage would be done. To prevent this it is arranged that when the carriage K is approaching either extremity of the screw it shall work a brake arrangement B B, which brings the machinery quietly to repose The act of putting the clutch-wheels T into position again also releases the brake. The clutch-wheels T are mounted on a spring, so that should their teeth not correspond when they are put into gear, one will give and wait for the other to overtake it.

It is desirable that the clock L should drive C C with great uniformity; and as the time of a conical pendulum is affected in a very great degree by any variation in the force of the clock-train, a special governing arrangement, the invention of the Astronomer-Royal, is employed. U (see Fig 4) is a trough filled with glycerine and water. Power reaches the pendulum by means of its connection with the vertical spindle seen at the centre of the trough, which rises from the clock-work. In this connection there is a joint, and a dipper D forms part of it. Too much power drives out the pendulum, and it would then go faster, were it not that the dipper, entering the glycerine and water more deeply, checks its motion On the other hand, whenever the power falls off the pendulum performs a smaller circle, thereby lifting the dipper a little more away from the liquid, and diminishing the resistance in exactly the same proportion as the force. The pointer X is a very delicate index of the angle the pendulum is swinging. The compensatory action of this governor is very considerable, doubling the power produces no perceptible difference in the time. The quickness with which it works is surprising, an infinitesimal change in the power is immediately indicated on the scale A, showing how well the apparatus is doing its work.

To prevent damage to the governor and the more delicate clock-wheels by any sudden check to the cylinder, a ratch-wheel arrangement has been introduced, which, when the cylinder is suddenly stopped, enables the pendulum to run on until it comes to rest gradually, by want of power.

Fig 1 gives a very faint idea of the dimensions of the apparatus The cylinder C C is 12 inches in diameter, and 30 inches long. Its weight is about 70 lb. The space between each seconds prick is $\frac{3}{10}$ inch, and the distance between the successive turns of the spiral of pricks $\frac{3}{20}$ inch. There is room on the paper for 200 spirals, and as each is more than one yard long, we can get more than 200 yards ($6\frac{2}{3}$ hours) of continuous observation without disturbing the instrument. There is always a spare cylinder covered with paper kept ready to replace the first.

The iron base-plate on which the instrument is mounted weighs over 3 cwt., the rails on which the carriage K runs are cast in one piece with it, and, along with all other bearing surfaces are planed. The pendulum, which weighs some 18 lb., and is compensated, goes round once in two seconds. Its suspension-piece weighs 2 cwt. As

regards the accuracy of the construction of these chronographs, the best criterion is to be found in the force that is required to work them. We find that 7 foot-pounds per hour drives the clock-work and pendulum; 7 foot-pounds more drives the carriage as well; and only 3 foot-pounds more is wanted for the cylinder—17 foot-pounds per hour for the whole instrument. Considering the resistance of the carriage, the resistance of the glycerine, and the weight of the cylinder, we think the result as surprising as it is satisfactory

THE BELGIAN ENTOMOLOGICAL SOCIETY

IN April, 1855, a circular with ten signatures was addressed to entomologists residing in Belgium, proposing the formation of a National Entomological Society, the students of Insecta and allies having at that time no organisation, no central meeting-place for interchange of ideas, no special medium in which to publish the results of their researches. The proposal was met by cordial approval, and the first volume of the *Annales* of the newly-formed Society, published in 1857, indicated a strength of forty-seven effective and four honorary members, with Baron de Selys-Longchamps as president. At first its publications were occupied almost entirely by subjects concerning the Belgian fauna, the volumes were thin, and each represented the work of more than one year. The Society was however well grounded, and notwithstanding occasional short periods of depression, it gradually increased in the number of its members, in the wideness of the scope of the papers read at its meetings, and in reputation as one of the leading entomological societies. Naturally the size of the volumes of the *Annales*, and the frequency of their appearance, also increased, and now the Society produces a volume each year that no similar society need be ashamed of. The twenty-second volume appeared in 1879, showing that the weakness inherent on infancy was soon overcome. The list in this volume shows a total of 171 effective Members (including many foreigners, of whom, however, only six are our own countrymen), twelve Honorary Members (including Messrs. Stainton and Westwood), with the addition of Corresponding and Associate Members It had also at that time acquired the distinction of being recognised by the State and of receiving a certain amount of State aid.

On October 18, 1880, the Society celebrated its twenty-fifth anniversary, rejoicing in the attainment of more than its majority, on which occasion the present President (M. Weinmann) read a short congratulatory address, and the indefatigable secretary (M. Preudhomme de Borre, to whom the Society owes much of its recent success) gave an instructive sketch of the history and progress of the Society On that occasion an especial honour was bestowed upon its first president, Baron de Selys-Longchamps (recently elected President of the Belgian Senate), by conferring upon him (in spite of his protestations) the title of Honorary President, a graceful tribute to one who for so long had continually used his energies, his social and scientific position, and his purse in furthering its interests.

Even apart from purely scientific considerations, the history of Belgium is so indissolubly mixed up with our own, and the feeling of fraternity so close, that all students of entomology in this country cannot but reciprocate the mutual congratulations that passed on this occasion between the native members, and the hearty and unaffected demonstrations of friendship accorded to our own entomologists who have attended the meetings of the Society show how warmly they welcome those of the foreign members who occasionally visit Brussels. The meetings are held in a room in the Royal Natural History Museum, in which is the library, and in connection with the entomological collection of the Museum. The annual subscription is small, and entitles the members to receive all the publications, including elaborate separate reports of the proceedings at the monthly meetings. We hope soon to see Englishmen figuring far more numerously in the lists of members. R. McL.

A GENERAL THEOREM IN KINEMATICS

THE following theorem with regard to the motion of a rigid body will doubtless be interesting to mathematical physicists —

In all cases of the motion, parallel to one plane, of a rigid body there is at every instant a point, J, of no acceleration, in the plane of motion; the acceleration of every point, P, in the plane is in magnitude directly proportional to the distance, JP, and its direction makes with JP an angle which, though varying with the time, is at any instant the same for all points in the body.

If ω is the angular velocity of the body at any instant and $\dot{\omega}$ the angular acceleration, the angle between JP and the direction of acceleration of P is

$$\tan^{-1}\frac{\dot{\omega}}{\omega^2}$$

We have therefore in all cases of uniplanar motion of a solid body an *instantaneous acceleration centre*, which is analogous to the ordinary instantaneous [velocity] centre.

Of course the ordinary equation

$$I\dot{\omega} = L,$$

which holds for motion round an axis fixed in space and in the body, and which expresses that the moment of the external forces about the axis is equal to the moment of the forces of inertia, holds also for the instantaneous acceleration centre.

As a particular case, whenever a solid moves with constant angular velocity, the accelerations are all directed towards the same point at any instant, and it follows that the resultant stress exerted over the surface of any little lump of the matter is a force directed to this point, if no continuous forces act

This centre can be in any case geometrically constructed by a rule analogous to that for the ordinary instantaneous centre

When I had hit upon this theorem I mentioned it to Prof. Wolstenholme, who at once looked out for its extension to three dimensional motion The result is very simple.

In all cases of the motion of a solid body there is at every instant a point, J, of no acceleration, and if at J there be drawn two axes, JA and JB, which are those respectively round which the resultant angular velocity, ω, and the resultant angular acceleration, $\dot{\omega}$, take place, the acceleration of any point, P, is compounded of two—one along the perpendicular, p, from P on JA, and the other perpendicular to JB and to the perpendicular, q, from P on JB, these two components being, respectively,

$$\omega^2 p \text{ and } \dot{\omega} q.$$

It seems surprising that such a simple and general property of the motion of a rigid body should not have been well known long ago GEORGE M. MINCHIN

Royal Indian Engineering College,
Cooper's Hill, November 6

NOTES

THE awards of medals for the present year made by the President and Council of the Royal Society are as follows:—The Copley Medal to Prof. James Joseph Sylvester, F.R.S., for his long-continued investigations and discoveries in mathematics; a Royal Medal to Prof. Joseph Lister, F.R.S., for his contributions on various physiological and biological subjects published in the Philosophical *Transactions* and *Proceedings* of the Royal

Society and elsewhere, and for his labours, practical and theoretical, on questions relating to the antiseptic system of treatment in surgery; a Royal Medal to Capt. Andrew Noble, F.R.S., for his researches (jointly with Mr. Abel) into the action of explosives, his invention of the chronoscope, and other mathematical and physical inquiries, the Rumford Medal to Dr. William Huggins, F.R.S., for his important researches in astronomical spectroscopy, and especially for his determination of the radial component of the proper motions of stars, the Davy medal to Prof. Charles Friedel of Paris for his researches on the organic compounds of silicon, and other investigations.

WE regret to have to record the death of M. d'Almeida, secretary of the French Société de Physique, and editor of the *Journal de Physique*. M. d'Almeida published a "Traité de Physique" in collaboration with M. Boutin. The *Comptes rendus* of the Academy of Sciences contain a number of his memoirs.

MR. SPOTTISWOODE, president of the Royal Society, was present at the sitting of the French Academy of Sciences on the 15th inst. He witnessed experiments made at Meritens' workshop on the magneto-electric engines which have been ordered by the Trinity House. The trials were successful.

SIR EDWARD REED writes from Corunna to the *Times* of yesterday, pointing out, as we were able to do last week, that the reports as to the injury sustained by the *Livadia* have been greatly exaggerated, and were not more than a few Clyde shipwrights could have repaired in a couple of days. There was no difficulty in getting the two injured compartments put to rights, barring the laziness of the French shipwrights. The *Livadia* returns to Ferrol for the winter, as her services are not required by her Imperial owner.

FURTHER details concerning the earthquake in Austria on the 9th confirm the reports as to its extent and severity. At Agram there were three shocks—the first, at 7.24 a.m., was the most formidable and lasted ten seconds; the second, also severe, occurred at 7.30, while the third, which was much the weakest, took place at 8.28 a.m. The first shock is described as circular. It was followed by violent oscillations from north-north-east to south-south-west. After it the whole town was covered by a dense cloud of dust caused by the falling down of chimneys, walls, and houses in every direction. From Laibach, Marburg, Klagenfurt, Kanizsa, Serajevo, Derwent, Brod, Pola, Trieste, Cilli, and the region of the river Drave, intelligence has been received of more or less severe shocks about the time of the first great shock in Agram. The earthquake was also felt in both Vienna and Pesth, but so slightly that it attracted the notice of only a few persons. The direction of the motion was everywhere the same, from north-east to south-south-west. As far as can be judged from the information hitherto received, the movement extended from the 44th to the 48th degree north latitude, and from the 32d to the 37th degree of east longitude (Ferro). From almost every district on the right bank of the Danube there is news of a greater or less disturbance with more or less damage done, while from the other side there is no such intelligence from even a single place. It was also felt at Szegedin and on the Theiss. Slight shocks were also felt on the night of the 9th and morning of the 10th, at Agram, and at noon on the 11th, a shock caused a number of houses to fall; the last was preceded by slighter shocks at 5.30 and 11 a.m. The disturbance was continued on the evening of the 11th, and on the morning, afternoon, and evening of the 12th. In the neighbourhood of Agram two mud volcanoes are said to be formed and in full eruption, and several hot springs have risen. The earth has also been rent in many places in the open country, and considerable quantities of mud with hot water and sulphur have been thrown out. The Vienna correspondent of the *Times* writes under the date of November 14: "The earth has been rent in many places in the open country, and considerable quantities of mud and hot water with sulphur have been thrown out. One of the largest of these rents is near the village of Resnik. Agram has often been visited by these earthquakes, especially within the last few years. Indeed scarcely a year has passed without more or less violent shocks." On the night of the 15th–16th there were at least five shocks at intervals between midnight and 4 a.m. Geologists have gone from Vienna and Berlin to Agram to study the phenomena more closely.

MR. J. MUNRO has drawn our attention to the fact that in NATURE, vol. xviii. p. 169, there appeared a short letter signed "J. F. W." and dated from Kew, June 3, 1878, suggesting the principle of Prof. Bell's photophone. The letter is as follows:—"Till now I have looked in vain for any account in NATURE of experiments with the telephone or phonoscope, inserted in the circuit of a selenium (galvanic) element (see NATURE, vol. xvii. p. 312). One is inclined to think that by exposing the selenium to light, the intensity of which is subject to rapid changes, sound may be produced in the phonoscope. Probably by making use of selenium, instead of the tube-transmitter with charcoal, &c., of Prof. Hughes, and by exposing it to light as above, the same result may be obtained. I should be glad to know whether experiments have been made in this direction, for if the above should prove true, there is no doubt that many applications would be the result."

OUR entomological readers will be glad to know that Mr. McLachlan will still continue his valuable services to the *Zoological Record*, reporting as usual on the groups of the Neuroptera and Orthoptera. Mr. Rye will henceforth confine himself to editorial work, while the groups hitherto recorded by him will be undertaken by Mr. Kirby, who will also do the Coleoptera.

LARGE additions are now being made to the Muséum d'Histoire Naturelle in the Jardin des Plantes at Paris. A new front is being erected and two new sides, which, combined with the former "Galerie," will form a hollow square. This square will be covered with glass and used for the exhibition of skeletons of whales and other specimens of inordinate dimensions. The total cost of these buildings is estimated at five million francs (160,000*l*.).

UNDER the auspices of the Russian Geographical Society M. Merejkovsky has been investigating the prehistoric anthropology of the Crimea. He has explored numerous caverns and made large collections of skulls, and the conclusion he comes to is that the age of stone in the Crimea may be divided into three periods: 1. Diluvian period, with mammoth fauna and arms of large dimensions, rudely worked. 2. Alluvial period, with contemporaneous fauna and the use of the arrow. 3. A later period, remarkable for the use of stone arrows, with scarcely any arms of large dimensions. In the Ural M. Malakhof has obtained important results, both geodetical and anthropological. He believes he has discovered on the Neiva, 75 versts from Ekaterineborg, traces of a prehistoric city.

A REGULAR analysis of the air is carried on by M. Davy at Montsouris. It has been found that the number of bacteria was twice greater than usual during the last period of high mortality.

THE President of the French Republic has established telephonic communication between the Elysée and the Chamber of Deputies, as well as the Senate. The first message of this instrument was the intelligence that the Cabinet had been placed in a minority.

AN interesting exhibition took place on Sunday, the 14th, at the Paris Conservatoire des Arts et Métiers, Rue St. Martin. The *portefeuille* of Vaucauson was opened for the first time to

public inspection. On this occasion the most important documents of this collection were affixed to the walls, with a number of other articles belonging to the archives. The most interesting is certainly the original letter written by Fulton to Mollard explaining to him the principles of steamboat construction. The letter is very long and exhaustive, and is accompanied by a drawing. M. Mollard returned a very cold answer after having meditated for a full month, and he says that "Mr Fulton's communication will be lodged in the archives of the Conservatoire." The date of Fulton's communication is the beginning of Pluviose, An. 11; Mollard's answer is not exhibited, but has been seen by our correspondent.

THE Jablochkoff light has been introduced by M. Hervé Mangon into the Conservatoire. It will be fed by a Gramme machine, which the establishment has purchased for its constant use. The light will be placed in the amphitheatre, where M. Hervé-Mangon delivers, twice a week, his own lectures.

THE lighting of the Victoria Station of the District Railway by means of the Jablochkoff electric light has been so successful that it has been also applied to the Charing Cross Station, and will shortly be introduced at Earl's Court.

M. MARTIN is engaged in polishing the object-glass of the large refracting telescope now building at the Paris Observatory. The diameter of this exceptional lens is 73 centimetres, and its weight 200 kilograms. The quality of the glass having proved defective it has already broken twice, and the operation is now being made on the third casting.

ON the occasion of the opening of the Ronalds Library at the Society of Telegraph Engineers, a considerable number of rare and curious books relating to electricity, magnetism, navigation, &c., was exhibited. A list of these has been printed and would be valuable to any one interested in the history of the departments of science concerned.

A GOOD example of the thoroughness of German education is given in the publication by Brockhaus of Leipzig of an "English Scientific Reader," edited by Dr. F. J. Wershoven, its purpose being to familiarise students with the style and terms used by the best English scientific writers. The first part relates to physics, chemistry, and chemical technology, and the extracts are made with great judgment. Among the authors from whom selections are made are Clerk-Maxwell, Fleeming Jenkin, Crookes, Roscoe, Lockyer, Rankine, Bloxam, George Wilson.

WE have received the first two volumes of a new "Bibliothèque Belge," for the popularisation of the sciences and arts, published at Mons by Manceaux. The two volumes received are "Traité élémentaire de Météorologie," by MM. J. C. Houzeau and A. Lancaster, two names well known in connection with this subject, and "Zoologie élémentaire," by Prof. Felix Plateau, whose name must also be familiar to our readers in connection with original research in a special department of the subject. Both volumes are well printed and illustrated. Among the volumes to follow are "Palæontology and Conchology," by A. Briart; "Geology," by F. Cornet, "Botany," by F. Crépin; "Mineralogy," and "Mineral Physiology," by L. L. de Koninck; "Mechanics," by H. Hubert, "Astronomy," by M. Niesten, "The Beginnings of Animal Life," by E. van Beneden, and "Physics," by vand der Mensbrugghen.

PROF. CORNELIUS DOELTER of Gratz was to proceed on the 15th inst. to Paris, thence to set out on a mission of scientific investigation to West Africa.

ACCORDING to official reports of the statistics of Bosnia and Herzegovina, these contain 1272 parishes, 43 towns, 31 markets, 5042 villages, 189,662 houses, 200,747 dwellings. Of the 1,158,440 inhabitants 607,789 are male, 550,681 female, 448,613 Mahommetan confession, 496,761 Greek-Oriental, 209,391 Roman Catholic, 3426 Jewish, 249 other confessions.

THE Procureur-General of Paris having complained, in his official address on the occasion of the opening of the courts, that the legal experiments in cases of poison were executed without sufficient precautions being taken against the professional prejudices of the operator, all the medical advisers of the criminal courts in Paris sent in their resignation, after having taken the advice of the Dean of the School of Medicine and other scientific authorities. Their number is nineteen.

A FAIRLY satisfactory Report is given by Surgeon-Major Bidie on the Government Central Museum at Madras. The number of visitors, especially female, continues to increase, and the special arrangements for native ladies attracted an average of 116 on the afternoon of the first Saturday of each month.

THE *Garden* has increased its size and reduced its price, introducing several improvements.

LORD GIFFORD, one of the Scotch judges, in opening the session at the Edinburgh School of Art the other day, summed up very neatly the advantages which a full and accurate scientific knowledge would bestow on those who were engaged in any practical work whatever—(1) That scientific knowledge of their subject would make work, whatever it was, intelligent, not mechanical; (2) it would make their work skilful and easy, (3) it would enable them to produce more exact and perfect work; (4) it would make their work advancing and progressive; and (5) it would make their lifework in itself delightful, and a source of pure and profound joy.

A VERY favourable Twelfth Report of the Working Men's College is issued. This institution completed its twenty-fifth year last year, and during its existence has doubtless done much good. The science classes have attracted an increasing number of students in recent years.

UNDER the title of "The Free Libraries of Scotland" some useful information is brought together in a pamphlet by "An Assistant Librarian." The towns in Scotland in which there are free libraries are Airdrie, Dundee, Forfar, Galashiels, Glasgow (Mitchell Library), Hawick, Paisley, Thurso. The University towns of Edinburgh, Aberdeen, and St. Andrews are still without such useful institutions; the Act has been adopted in Inverness and Dunfermline, Arbroath has twice rejected the proposal to adopt the Free Libraries Act.

WE are glad to notice that the Highbury Microscopical and Scientific Society is increasing in numbers and has some good papers promised for the new year. It gave its fourth annual *soirée* at Harecourt Hall on October 14, and the president, Mr. Frederick Fitch, F.R.M.S., gave his address on the "History of the Microscope and Microscopic Research" on October 28. On Saturday, the 13th inst., a visit will be paid to the Museum of Practical Geology under the guidance of Prof. Rudler, F.G.S.

IN the *Transactions* of the Royal Society of Victoria, April 1880, recently received, the Rev. R. H. Codrington contributes some valuable "Notes on the Customs of Mota, Banks Islands." Since Mr. Tylor in his "Early History of Mankind" so graphically sketched the remarkable custom of the "*couvade*" all information as to its further geographical distribution is ethnologically valuable, and Mr. Codrington here adds the Banks Islands to the area in which it is practised. There is also a tradition that among the inland mountains there is or used to be a race of wild men, which agrees with the stories that are current in most of the Asiatic Islands. The *Mota* practices here described are not to be confounded with those of the *Motu* of New Guinea.

A NEW destructive insect is recorded from America; *Cetonia inda*, a beetle which, according to the *American Naturalist*, was harmless, feeding on the sap of freshly cut maple-trees, has within two or three years become very abundant and destructive in different parts of New England. During the past summer it collected in great numbers on green corn, "eating the kernels and partly destroying a field in Middleboro, Mass."

FAVOURABLE reports reach us as to the thriving condition of the Botanical Gardens, Peradeniya, Ceylon, under the direction of Dr. Trimen, who recently succeeded Dr. Thwaites. In the experimental nurseries, our contemporary the *Colonies* says, good work was being done. Every effort was being made to extend the cultivation of *Cinchona*, the export of which for the season, up to the date of latest advices, had been 1,135,236 lb. In the district of Kotmale report represented the india-rubber tree as flourishing, and the export of its valuable juice from the colony may, it is hoped, be eventually looked upon for supplementing the falling off in export of this valuable article from the forests where it is indigenous.

THE *Colonies and India* draws attention to the riches of the New Zealand forests in their indigenous timbers. Though the woods of New Zealand, like those of Australia, are by no means unknown in this country, owing to the assistance afforded for making their acquaintance through the various International Exhibitions, they are nevertheless almost unknown in commerce in consequence of their extreme hardness and the cost of freight in bringing such heavy material so long a distance. Our contemporary thinks that the timbers "will become of much greater value when it is more generally known when to cut and how to season them." We are told that experiments in this direction are being made in order to test their value for various purposes. Several of the best woods are enumerated, and it is said of the "Matai" (*Podocarpus spicata*) that Mr Buchanan "reports having found a tree of this species prostrate on a piece of land near Dunedin, which from various circumstances was estimated to have been exposed for at least three hundred years in a dense damp bush under conditions most favourable to decay. It was still however sound and fresh."

MAMMEE APPLES (*Mammea americana*) are, we understand, being exported in quantities from the West Indies to New York. The result of the experiment is being watched with some interest.

IN the last number of the *Revue d'Anthropologie* has appeared not only an excellent photograph of the late Dr. Paul Broca, but also a biographical sketch and a complete list of his various contributions to science. His contributions to medical science commence in 1847, and his first anthropological memoir bears date 1850, from these dates to the time of his death this "Bibliographie" is a record of both untiring industry and scientific production, which will be remembered as long as anthropology remains a science.

OUR ASTRONOMICAL COLUMN

THE SOLAR ECLIPSE OF DECEMBER 31.—Although the eclipse of the sun on the last day of the present year will not in any part of these islands amount to six-tenths of the sun's diameter, it is nevertheless as large a one as will be visible until May 28, 1900, and only that on the morning of June 17, 1890, will compare with it in magnitude in the interval. The *Nautical Almanac* furnishes the results of direct calculations for Greenwich, Edinburgh, Dublin, Cambridge, Oxford, and Liverpool. If to the results for the former three observatories we apply the very convenient Littrow-Woolhouse method of distributing the predictions, we shall have the following formulæ for finding Greenwich mean times of first contact, greatest phase and last contact, and the magnitude of the eclipse at any place within or near to the area comprised:—

		h. m		
First contact	=	1 41.14	− [9.9891] L	+ [9.6113] M
Greatest phase	=	2 36.32	− [9.7942] L	+ [9.3838] M
Last contact	=	3 28.63	− [9.4618] L	+ [8.7599] M

Where the latitude of the place is put = 50° + L, and M is the longitude from Greenwich in minutes of time reckoned positive to the east, and negative to the west. Quantities in square brackets are logarithms.

Or the following may be substituted with sufficient accuracy, the factors of L and M being now numbers:—

		h. m		
First contact	=	1 41.14	− 0·98 L	+ 0·41 M
Greatest phase ...	=	2 36.32	− 0·62 L	+ 0·24 M
Last contact	=	3 28.63	− 0·29 L	+ 0·06 M

and the magnitude will be = 0·368 + 0·013 L − 0·002 M. If we test these formulæ upon Oxford, the latitude of which is 51° 45′ 36″, longitude 5m. 2·6s. W., we have then L = + 1·76°, and M = − 5·04m., then for first contact the expression becomes 1h. 41·14m. + 1·76 × − 0·98 − 5·04m. × 0·41 = 1h. 41·14m. − 1·72m. − 2·07m. = 1h. 37·35m. Greenwich mean time, or applying the longitude − 5·04m. = 1h. 32·3m. agreeing with the *Nautical Almanac*, and similarly for the other phases. The differences from direct calculations will be within 0·2m., if the place is not too distant.

THE DUNECHT COMET.—There appears to be no doubt now that the comet discovered by Mr. Lohse at Lord Lindsay's Observatory on November 7 is the same as that detected by Mr. Lewis Swift at Rochester, N.Y., on October 11, which had not been previously observed in Europe. The elements, according to the calculations of Mr. S. C. Chandler, jun., of Boston, U.S., and those of Dr. Copeland and Mr. Lohse at Dunecht, have great resemblance to the elements of the third comet of 1869, discovered by M. Tempel, and there seems a probability that he may thus be found to have detected no fewer than four comets of comparatively short period. If the revolution of this comet should prove to be performed in a little less than eleven years it will be found that it must approach very near to the orbit of Mars shortly before the descending node, and, which is of more importance, within 0·4 of the earth's mean distance, from the orbit of Jupiter in about heliocentric longitude 257°. Mr. Chandler sends us elements calculated from approximate positions on October 21, 25, 28, and in his letter dated November 2 points out their great similarity to those of the Comet 1869 III., and in a circular received from Lord Lindsay we find an orbit computed from Dunecht observations on November 7, 9, and 10, we have thus for comparison:—

	Comet of 1880 Chandler	Copeland and Lohse	Comet of 1869 Bruhns
T	Nov. 7·714	Nov. 6·6127	Nov. 20·7168
	° ′	° ′ ″	° ′ ″
π	41 41·0	40 24 10	41 17 13
Node	295 25·4	300 49 41	292 40 29
ι	7 21·7	7 22 13	6 55 0
Log. q	0·04262	0·043314	0·042416
Motion	Direct	Direct	Direct.

Mr Chandler's T is for meridian of Washington, the other two for that of Greenwich. An ephemeris which he adds proves the identity of Swift's comet with that found by Mr. Lohse.

It may be remarked that, taken as a whole, there is a distant resemblance to the elements of the comet of Biela.

INTRODUCTORY LECTURE TO THE COURSE OF METALLURGY AT THE ROYAL SCHOOL OF MINES[1]

THE distinguished metallurgist who has held this lecturership since the foundation of the Royal School of Mines, concluded the introductory lecture he delivered more than a quarter of a century ago[2] by pointing out to the students who were then beginning their course that "in proportion to the success with which the metallurgic art is practised in this country will the interests of the whole population, directly or indirectly, in no inconsiderable degree be promoted." This is a fact that none of his students are likely to forget.

Looking back on the actual advance of this country during the

[1] By Prof. W. Chandler Roberts, F.R.S., Chemist of the Mint. Condensed by the Author.
[2] *Records* of the School of Mines, vol. i. pt. i. (1852) p. 127.

past thirty years, and remembering that the success with which any manufacturing art is practised must bear a direct relation to the way in which it is taught, we cannot but feel how greatly this development of metallurgical knowledge must have been influenced by Dr. Percy's labours. During this period the conditions under which metallurgy is practised have changed considerably, for the field of knowledge has so widely extended, the scale on which operations are conducted is now so great, and the mechanical appliances they involve are so varied and complicated, that while the interest of our subject is deepened its difficulty is gravely increased.

In turning to the history of metallurgy, more especially in its relation to chemical science, it is easy to be led away by the charm of the antiquarian riches of our subject into devoting too much time to this kind of literary research, I may remind you however that much of what is both interesting and full of suggestion, even at the present day, is to be found buried in the treatises by the old writers whose work we inherit and continue.

Primitive metallurgical processes are referred to in some of the oldest known historical records, naturally therefore the development of metallurgy as a science must have been long preceded by its practice as an art, an art for which a place has even been claimed among the religious systems of antiquity [1] The earlier literature of the subject consists mainly of descriptions of processes, but it is well known that chemistry was to a great extent built up on a metallurgic basis, and Black's singularly advanced definition of chemistry as the "effects produced by heat and mixture" [2] might well be applied to metallurgy But of all the phenomena of our subject, probably none have more contributed to advance the science of chemistry than those bearing upon the relations between oxygen and lead, indeed the interest attaching to the mutual behaviour of these two elements is so great that I propose devoting a few minutes to its consideration, more especially as I am anxious to indicate the influence of an ancient process on the scientific views of the present day

When lead is melted with free access of air, a readily fusible substance forms on its surface. This substance may be allowed to flow away, or if the metal is contained in a suitable porous receptacle, the fusible oxide sinks into this containing vessel, in either case the oxidation of the lead affords a means of separating it from precious or inoxidisable metals if any were originally present in the lead. The above fact has been known from remote antiquity, and the early Jewish writers allude to it as old and well known. They clearly show, for instance, that lead can be removed from silver by being "consumed of the fire," while the silver is not affected That the Greeks knew and practised the method is abundantly proved, if only by certain specimens of gold and silver now in the adjoining museum, which were recently discovered by Dr. Schliemann The Arabians investigated the subject, for passing to Geber,[3] the greatest of the early chemists (he died in 777), we find a remarkable account of cupellation, he also describes the conversion of lead into a fine powder by calcination with much clearness, and he noticed the fact that after calcination the mass has "acquired a new weight in the operation." I think his subsequent observations on the reduction of altered metals from their "calxes" show that he knew the weight to be increased; in any case it is interesting to remember that his work was in a sense quantitative He moreover was cognisant of the fact that two different substances may be produced by heating lead in air, and he assumed that "in the fire of calcination a fugitive and inflammable substance is abolished." The alchemists refer continually to the subject, and "deliver themselves," as Roger Bacon said, in his "Speculum Alchimæ," "in the enigmas and riddles with which they clouded and left shadowed to us the most noble science" In the middle of the sixteenth century the truly accomplished metallurgist Biringuccio,[4] contemporary of Paracelsus and Agricola, seems to have been specially attracted by the phenomenon in question, and he remarks. "If we had not lead we should work in vain for the precious metals, for without its aid we could not extract gold or silver from the stones containing them. . . The alchemists also," he said, "make use of it in their operations, calcining it by itself or with other substances, but," he goes on to observe, "the calcination, conducted in a reverberatory furnace, is accompanied by a marvellous effect, the result of which should not be passed by in silence; for lead thus treated increases 10 per cent. in weight, and, considering that most things are consumed in the fire, it is remarkable that the weight of lead is increased, and not diminished." Although he subsequently gives evidence of much accurate knowledge of practical metallurgy, his views as to this particular phenomenon were hardly in advance of Geber's, but we may claim Biringuccio as an early metallurgist, who knew the facts, and recognised that they were theoretically important. It was not until nearly a century later (1630) that a French chemist, Jean Rey,[1] stated that the increase in weight came from the air. The problem attracted much attention in England, and it is not a little interesting that among the very first experiments recorded by our own Royal Society is a metallurgical series relating to the weight of lead increased in the fire on the "copels" at the assay office in the Tower, the account being brought in by Lord Brouncker in February, 1661.[2] [Subsequently, in 1669, John Mayo showed that the increase in weight of calcined metals was due to a "spiritus" from the air.[3] Boyle heated lead in a small retort,[4] and attributed the increase in weight, as Lemery also did,[5] to his having "arrested and weighed igneous corpuscles"[6]

I need hardly point out how important this calcination of lead was considered by those who defended the Phlogistic theory in regard to chemical change, a theory which, for more than a century, exerted so profound an influence on scientific thought. [As this theory originated with a metallurgist, Becker, it was considered at some length, and it was made evident that the main aim of chemical investigation down to the end of last century was the explanation of calcination, combustion, or oxidation, and that lead was especially useful in solving the problem]

I might perhaps add that the *absorption* of oxygen by molten litharge has furnished M. Ste. Claire-Deville,[7] a physicist and metallurgist, with an important step in the argument as to dissociation, and thus connects the history of the metal with the great advance on the borderland of chemistry and physics in modern times, to which I shall constantly refer.

The above remarks will, I trust, be sufficient to show that conclusions of the utmost importance in the history of chemical theory were based on a very ancient metallurgical process, but I have also selected lead as an illustration, because, in the gradual development of the knowledge derived in the first instance from its metallurgy, there is much that is typical of the mutual relation of theory and practice that still prevails

When Dr. Percy began his teaching, he considered at some length the kind of assistance that other sciences might be expected to render our subject, considered as a manufacturing art, and this at the time was necessary for two reasons,[8] first, because he was "able to adduce from his own observation several striking cases in illustration of the advantage of the application of science to practical metallurgy; and, second, because the practice of metallurgy, so far as relates to magnitude of operation, having been developed to an unparalleled extent in this country in the absence of specific public instruction on the subject, it was necessary to justify the providing of such instruction."

The absence of accurate knowledge on the part of those engaged in metallurgy was lamented as long ago as 1700, in an "Inaugural Dissertation of Pyrotechnical Metallurgy," delivered, on March 25 of that year, in the University of Magdeburg, no less a person than the great supporter of the theory of Phlogiston, George Ernest Stahl, presided, and the lecturer was

[1] Rossignol, "Les Métaux dans l'Antiquité" (1863).
[2] "Lectures by Joseph Black, M D," vol 1 p 8 (Edin., 1803)
[3] "The Works of Geber," translated by R Russell (1686), pp 74, 78, 220, 234
[4] "Pirotechnia" (Vinegia, 1540), translated into French by T. Vincent Rouen, 1627), p. 41.

[1] "Essays de Jean Rey" (reprinted in Paris, 1777), p. 64.
[2] MS Register Book of the Royal Society
[3] "Tractatus quinque Medico Physici," p 25 *et seq* (Oxonii, 1674).
[4] Collected works, vol iii (1744), p 347
[5] "Cours de Chymie" (1675) and English edition (1686), p 107
[6] I am indebted to my friend Prof Ferguson, M A, of the University of Glasgow, whose eminence as a historian of chemistry is well known, for several interesting additional facts in connection with the calcination of metals After referring to Eck (1489), Glauber (1651), and others, he writes "One of the most curious passages I know is in the 'Hippocrates Chemicus' of Otto Tachen, or Tachenius, a German who lived at Venice and published his book there in 1666 He describes how lead, when burnt to minium, increases in weight. This increase he ascribes to a substance of acid character in the wood used for burning, and then, by a very curious course of argument, based on the saponifying powers of litharge, makes out that lead is of the nature of or contains an alkali, which combines with the 'occult acid of the fat.' This is a curious anticipation of a very modern classification which brings lead into relationship with the alkalies and alkaline earths, as well as of Chevreul's investigations."
[7] "Leçons sur la Dissociation," 1864
[8] *Records* of the School of Mines, vol i pt i (1852), p 128.

Fritschius, who said:[1]—"If in any part of the working of metals there is commonly more owing to experience than reason, truly it is in fusion or melting . . . nevertheless if the reason be asked why the business succeedeth well in this way but in another doth not succeed at all, you have no solid answer, but only that most general one, which is most commonly false, viz that one fire is stronger and another weaker, and so insufficient" It is just a century since Bishop Watson, Professor of Chemistry and Regius Professor of Divinity in the University of Cambridge, pointed out[2] that "the improvement of metallurgy and other mechanic arts dependent on chemistry might best be made by public establishment of an Academy, the labours of which should be destined to that particular purpose," and the School of Mines, thus foreshadowed, was established in 1851, its principal object being to "discipline the students thoroughly in the principles of those sciences upon which the operations of the miner and metallurgist depend"

Our honoured founder, Sir Henry de la Beche, in his Address at the opening of the School of Mines,[3] said:—"We still too frequently hear of practical knowledge, as if in a certain sense opposed to a scientific method of accounting for it, and as if experience, without that advantage, was more trustworthy than the like experience with it." Such remarks might, with truth, be made at the present day; but it should nevertheless be remembered that many metallurgical works are successfully conducted in this country by so-called practical men. I do not mean the kind of man so forcibly described by Mr Bramwell[4] as one "whose wisdom consists in standing by, seeing, but not investigating the new discoveries which are taking place around him . the aim and object of such a man being to ensure that he should never make a mistake by embarking his capital or his time in that which has not been proved by men of large hearts and large intelligence," nor do I mean the man who accepts no rule but the "rule of thumb", but I do mean practical men possessing technical knowledge of a high order, whose careful observation enables them to use the results of past experience in dealing with circumstances and conditions analogous to those they have met with before, and with which long practice has made them familiar It would be difficult to overrate the value and importance of such knowledge as theirs, and, when we remember the scale on which smelting and other operations are carried on, it will be obvious that this kind of knowledge can only be gained in the works, and not in the laboratory or lecture-room, for, however careful the metallurgical teaching here may be, it can only be practical in a limited sense At the same time it must be borne in mind that a man trained to scientific methods starts with the enormous advantage of being able to deal with circumstances and conditions that are new to him, and with which therefore he cannot be said to be "familiar." The technical skill that time and opportunity can alone give him will then rest on a solid basis. I repeat, however, that I am anxious at the outset to guard against undervaluing the teaching of experience unaided by reasoning that we should recognise as scientific; for it is only necessary to witness such operations as the roasting of a large mass of ore on the bed of a furnace, or the forging of many tons of iron under a steam hammer, to appreciate the value of the subtle skill of sight and touch on which success depends

I have thus ventured to trace the relation between scientific and technical men, as hitherto there have been misunderstandings on both sides, or, as Dr. Williamson so well observes[5]—"Men of detail do not sufficiently appreciate the value and usefulness of ideas, or of general principles, and men of science, who learn to understand and control things more and more by the aid of the laws of nature, are apt to expect that all improvements will result from the development and extension of their scientific methods of research, and not to do justice to the empirical considerations of practical expediency, which are so essential to the realisation of industrial success in the imperfect state of our scientific knowledge."

While it is no longer necessary to justify the scientific teaching of metallurgy, as Dr. Percy did, it is as important as ever that the true relation of Theory and Practice should be clearly understood. It rarely happens that a process can be transferred from the laboratory to the works without important modifications; and we must remember that metallurgy is a manufacturing art, and that, when the truth of a theory has been demonstrated, a dividend has to be earned, this would indeed often be difficult without the aid of the technical man. Practical men have, however, ceased to undervalue science, and the most practical body of men in the world, in the best sense of the term, the iron masters of this country, on whom its prosperity so largely depends, formed themselves ten years ago into an Iron and Steel Institute, many of the members of which possess high scientific attainments and are distinguished for scientific research

Let us turn, then, to the advice given us by those who are accustomed to deal with metals on a large scale Mr. I Lowthian Bell stated in his address as president of the Institute in 1873[1]—"If we would avoid the failure of what may be designated unscientific practice, or the failure of impracticable science, we must seek to combine commercial intelligence with a knowledge of those natural laws which form the only trustworthy groundwork of the complicated processes in which we are engaged."

Dr Siemens[2] said in 1877,—"It is not many years since *practical* knowledge was regarded as the one thing requisite in an iron smelter, whilst *theoretical* knowledge of the chemical and mechanical principles involved in the operations was viewed with considerable suspicion," and he adds, with reference to the teaching of the School of Mines and of a general Technical University —"But it must not be supposed that I would advocate any attempt at comprising in its curriculum a practical working of the processes which the student would have to direct in after-life. . . Let technical schools confine themselves to teaching those natural sciences which bear upon practice, but let practice itself be taught in the workshop and in the metallurgical establishment"

The president for 1879, Mr E. Williams, a most eminently practical man, and one of the founders of the prosperity of the great Cleveland iron district, urged[3] "educated intellectual young men, who now hang listlessly about the professions . . to break through the absurd old prejudice against seemingly rough work," in order that they may act as scientifically trained managers

I have thus appealed to authorities, because my own practical work has been mainly confined to a limited branch of metallurgy. I say limited, for although, on looking into the matter, I find, to my surprise, that I have during the last ten years been responsible for the fineness of 330 tons of gold and 740 tons of silver, this, though of a total value of forty-seven millions sterling, is a comparatively small bulk of metal, and the operations through which it passes are seldom complicated; but I am none the less convinced that in metallurgical works generally, as in a mint, the work can only be efficiently conducted by taking advantage to the utmost extent of the aid that science has to offer, a mint only differing from other works by the extraordinary care and vigilance which must be exercised to insure accuracy and avoid loss in dealing with the precious metals. Even this difference is less marked than formerly, and as attention to minute details is becoming more and more essential to the profitable conduct of works, my experience in this respect will be useful to you

As regards the actual training in the school, I believe that our utmost efforts should be devoted to giving the students a thorough acquaintance with scientific methods and metallurgical principles, furnishing them at the same time with as many well-ascertained *facts* as possible. Here I may perhaps be permitted to quote a few words from Prof Huxley's[4] recent address at Birmingham, as they bear so directly on our subject, he said, "What people call applied science is nothing but the application of pure science to particular classes of problems It consists of deductions from those general principles, established by reasoning and observation, which constitute pure science No one can safely make these deductions until he has a firm grasp of the principles; and he can obtain that grasp only by personal experience of the processes of observation and of reasoning on which they are founded"

In one important branch of metallurgy—assaying—the teaching in the School is thoroughly practical, and the operations you may in future be called upon to conduct will not differ from those taught in this laboratory. The teaching will, I am glad to say, be now specially entrusted to my friend Mr. Smith, the value of whose instruction in my own case I gratefully acknowledge.

[1] "Pyrotechnical Metallurgy," by J C. Fritschius of Schwartzburg (translated in 1704), p. 203
[2] "Chemical Essays," 2nd edition (1782), vol 1 p. 47
[3] *Records* of the School of Mines, vol 1 pt 1 (1852), p 20
[4] British Association Report, Brighton (1872) p 238
[5] "A Plea for Pure Science" (Inaugural Lecture, University College, London, 1870)

[1] *Journal* of the Iron and Steel Institute (1873), No. 1, p 12
[2] *Ibid.* (1877). No 1, p. 7
[3] *Ibid.* (1879), No. 1, p. 24.
[4] NATURE, vol xxii p. 548.

It can hardly be questioned that until the School of Mines was established the metallurgical success and reputation of this country rested to a remarkable extent on the exceptional skill of its technical men. I think therefore we may fairly be asked to consider whether the metallurgical teaching of the School has been justified, and how far advance has been due to trained scientific thought.

Of all the metallurgical operations conducted in this country, those connected with iron are, of course, the most important. The production of pig iron alone in the United Kingdom has increased from two million seven hundred thousand tons in 1852 to six million two hundred thousand tons last year, a maximum slightly in excess of this figure having been reached in the year 1872. Now the Bessemer process, the first patent in connection with which was taken out in 1855, has reduced the cost of steel from 50*l.* to 6*l.* per ton, and has changed the whole aspect of the iron and steel manufacture; indeed, the success with which this process alone is conducted may almost be regarded as an index of our national prosperity. Notwithstanding the almost universal depression of trade during the last few years, the outturn of steel has been steadily increasing, and it is estimated that in 1879 this country produced nearly a million tons in the Bessemer converter, double the entire produce of the remainder of the world in the year 1870 by the same process.[1] The outturn of Bessemer steel in America has, however, advanced with still more rapid strides; for last year she actually produced, with far fewer converters, ninety-four thousand tons more than this country. It will be evident, therefore, that every improvement effected in this process is of truly national importance, and I would briefly refer to the greatest that has been introduced in recent years.

In 1855 the fact was established that pig-iron from the blast-furnace contains the greater part of the phosphorus originally present in the ore. Dr. Percy pointed out that phosphorus is not eliminated in a sensible degree in the Bessemer process, as it is in the old process of puddling, and he stated that if the Bessemer process is to be "generally applicable in this country, it must be supplemented by the discovery of a process of producing pig-iron sensibly free from sulphur and phosphorus, with the fuel and ores which are now so extensively employed in our blast-furnaces."[2] The problem, so far as it relates to the elimination of phosphorus, has received the attention of many of the first metallurgists in this and other countries,[3] but the practical application of basic linings in the Bessemer converter is the outcome of Dr. Percy's teaching; for Mr. S. G. Thomas was a student of the School of Mines, and his partner, Mr. Gilchrist, is an Associate. Mr. Snelus is also an Associate, and Mr. Riley long worked in the metallurgical laboratory. The process not only gives hope that it will be possible to utilise the large quantities of ore in the well-known Cleveland district, but is also widely practised with success on the Continent.[4] It is probable therefore that the large deposits of ore in the basin of the Saar, and those of Lorraine and Luxembourg, which in extent are equal to the Cleveland district, while containing a much greater amount of phosphorus, will now be available. During a recent visit to the Hoerde Works in Westphalia, where I witnessed the operation, Herr Massenez, the director, told me that 10,000 tons of "Thomas-Gilchrist" metal have already been produced there since the adoption of the process a few months ago.

I had intended to indicate the metallurgical work done by the more prominent men who have been associated with the school, but I found that it would not be possible, in the brief time at my disposal, to do justice to such as Bauerman, Dick, Gibb, Hackney, Matthey, Pearce, Riley, Willis, and others, whose labours have placed them so high in the ranks of English metallurgists. You will, however, as the course proceeds, have opportunity of becoming familiar with their names.

In referring to the past teaching of the school I must remind you of the importance of rigorous and minute inorganic analysis; and it is the more necessary that I should do so from the fact that the peculiar charm of organic research appears, as has been pointed out by Prof. Abel,[5] to lead the younger chemists to "under-estimate the value and importance, in reference to the advancement of science, of the labours of the plodding investigator of analysis." I am satisfied, however, that, if we bear the traditions of the chemical and metallurgical laboratories of the School of Mines in view, we are not likely to under-rate the importance of analytical work; and much conclusive evidence as to the value of the teaching of the past thirty years is afforded by the labours of the accomplished analysts who have from time to time worked under Dr. Percy's direction.

[1] *Times*, December 31, 1879.
[2] "Metallurgy—Iron and Steel" (1864), p. 819.
[3] M. Gruner, *Annales des Mines* (1869) t. xvi. p. 199.
[4] M. Gruner, *Annales des Mines*, part 1 (1879), p. 146; H. von Tunner, *Zeitschrift der berg- und hüttenmännischen Vereins für Steyermark u. Kärnten*, xii. Jahrg., Mai-Juni 1880; Herr J. Massenez, *Engineering*, vol. xxx. (1880), p. 198.
[5] British Association Report, Plymouth (1877), p. 44.

The direct influence of the School on the success with which metallurgy has been practised in this country has been most marked, and would alone afford an answer to the question whether the possession of high scientific attainments is generally advantageous to the successful conduct of metallurgical works. It must not be forgotten that our subject is constantly receiving valuable aid from branches of science other than chemistry, and this can hardly be better shown than by the growing importance of physical research in connection with metallurgical problems. I would incidentally remind you that it is the more important for us to consider this, because special attention was directed to the question in the evidence given before the Royal Commission on Scientific Instruction,[1] whose recommendations will, it is to be hoped, extend the influence of the School of Mines.

In connection with this branch of our subject a most prominent position must be given to the production of high temperatures, as it will be obvious that we have principally to consider the reactions of the elements when under the influence of heat. In the first half of the present century temperatures higher than the melting point of zinc were not known with any degree of certainty; but in 1856[2] M. Henri Ste. Claire-Deville pointed out that chemistry at high temperatures, that is to say, up to the blue-white heat at which platinum volatilises and silica fuses, remained to be studied. Since then, in conjunction with M. Troost, he has given us certain fixed points, such for instance as the boiling points of cadmium and zinc, and Deville's researches on dissociation have entirely modified the views generally entertained in regard to the theory of combustion. Indeed we owe so much to this illustrious teacher, that the best homage we can offer him will be to work in the directions he has indicated. M. Stas has proved that it is perfectly easy to distil even large quantities of silver from one lime crucible to another,[3] a fact which has been taken advantage of by Mr. Lockyer and myself in some experiments on the absorption-spectra of the vapours of certain metals at high temperatures.[4]

As regards scientific advance of a more essentially practical character, the gradual discovery of the fact that in certain cases fuel can be best employed if it be previously converted into gas, and the recognition of the advantages to be derived from a preliminary heating of the gases and the air, has led to the wide adoption of the regenerative system, by which the waste heat of the furnace is utilised for heating the incoming air or combustible mixture of air and gas necessary to effect the required operation. Dr. Siemens has thus shown us how to economise fuel to a vast extent, it being now possible to produce a ton of steel by the use of 12 cwt. of small coal instead of three tons of coke required to melt it in the old form of furnace. By the command of high temperatures, moreover, he has developed new processes in the metallurgy of iron, which are resulting in the replacement of the old "cinder-mixed" wrought iron by "cinder-free" ingot iron and steel.[5] The degree of heat attainable by the regenerative furnace is, however, limited to the temperature of dissociation of carbonic acid and aqueous vapour, so that the temperature never can exceed about 2600° C.; but during the present year[6] Dr. Siemens has employed the far greater heat of the electric arc for the fusion of steel and platinum.[7] Bearing in mind the interest excited by recent experiments on the effect of intense heat on bodies now considered to be elementary, we may expect physicists to look to us for aid in developing the methods of employing high temperatures.

The essential difference in the properties of certain alloys produced by a small difference of composition brings me to one very distinctive feature of metallurgy, the enormous influence

[1] Report, vol. ii. Minutes of Evidence, p. 86 (1874).
[2] *Ann. Chim. et Phys.* [3], t. xlvi. p. 182; *Comptes rendus*, t. xc. (1880), p. 773.
[3] "Sur les Lois des Proportions chimiques" (1865), p. 37.
[4] *Proc.* Roy. Soc. vol. xxiii. (1875), p. 344.
[5] Akerman, *Journal* of the Iron and Steel Institute, No. 2 (1878), p. 360.
[6] *Engineering*, vol. xxix. (1880), p. 478.
[7] Figures convey but little impression as to such high temperatures, but it may be mentioned that Dewar has given 7000° C. as approximately the temperature of the electric arc (Brit. Assoc. Rep. 1873, p. 466), and, according to Rossetti, the true temperature of the sun can hardly be less than 10,000° C. or more than 20,000° C.—*Phil. Mag.* [5], vol. viii. p. 550 (1879).

exerted on a large mass of metal by a trace of another metal or metalloid—that is, by a quantity so small that it appears to be out of all proportion to the mass in which it is distributed.

I think it may safely be asserted that in no other branch of applied science has the operator to deal with quantities that are at once so vast and so minute; and the course will not have proceeded far before you will recognise this fact.

It may be that the trace to be extracted is alone of value—as, for instance, the few grains of gold that can be profitably extracted from each ton of a material, which, though containing only one part of gold in five millions by volume, is thereby entitled to be regarded as an auriferous deposit that can be profitably worked; or it may be the minute percentage of a metalloid which must be extracted in order that the physical properties of a large mass of metal may not be entirely altered.

[Numerous instances of the influence of small traces of metals and metalloids, including the following, were then given —]

In 1866 Graham showed,[1] by experiments with which I had the privilege of being connected, that the presence of occluded gases in metals often exerts a marked influence on their molecular structure. In the case of iron he urged that metallurgists should study the effects of occluded gases, more especially carbonic oxide, the weight of which, according to his experiments, could not exceed the $\frac{1}{10}$ per cent. of the weight of iron in which it was present The significance of such facts is now under consideration by a Committee of the Institution of Mechanical Engineers,[2] and the question of the presence of gas in steel, either occluded or retained in the form of bubbles, is further being investigated by Chernoff,[3] Muller,[4] and others.

M. Nyst, of the Brussels Mint, has lately found that the presence of $\frac{15}{100}$ per cent of silicon in standard gold will so affect its molecular grouping as to render it possible for a thin strip to bend by its own weight, as zinc would, in the flame of a candle.

The growing importance of physical research in connection with metallurgy is shown by the fact that physical methods are now constantly appealed to by those interested in metallurgy, more especially in the case of iron and steel. We are told, for instance, that the hardness of steel may be correctly inferred from a numerical determination of its coercive force,[5] it is sought to establish the actual nature of the change in the mode of existence of the carbon in steel that accompanies hardening by determining its thermo-electric properties,[6] and the hope is held out[7] to us that the time will soon come when boiler-makers will electrically test their plates, possibly by the aid of the induction-balance, just as they now test them for ductility and tenacity I can only add the expression of a belief that this powerful weapon of molecular research which Prof Hughes has given us will yield good results in the hands of some of you

The results of mechanical tests are also of the highest importance. Not long since the appearance of the fracture of a sample of metal was considered to afford trustworthy and sufficient evidence as to its nature and properties, but such rough methods have given place, in the hands of Kirkaldy and others, to the rigorous physical and mechanical investigation to which metals must now be submitted as a matter of ordinary routine. The results, tabulated or plotted into curves, which mark the influence of each constituent or impurity, form permanent records of the greatest value[8]

It has only been possible for me to indicate the more important conditions affecting the successful practice of metallurgy I have traced the relation between technical and scientific workers, but there is yet another condition of somewhat recent growth. The enormous scale on which operations are now conducted renders it more necessary than formerly for those engaged in metallurgical enterprise to seek the aid of capitalists. The result is that a large share in the control of many important works falls to the non-scientific members of the Board of Directors, men of high commercial ability, but whose knowledge of the importance of scientific work is necessarily limited. It is true that they may recognise the necessity for scientific aid in the works with which they are connected, but they are too often unconscious of the labour and difficulty that are involved in the attainment of accurate scientific knowledge. I am convinced, however, that facts are gradually compelling them to recognise that the value of a metal may entirely depend on whether it does or does not contain a trace of impurity, and that the exact method of treatment to be adopted depends much on the character of the materials employed, they will therefore examine more carefully than they have hitherto done the qualifications of men to whom important duties are entrusted, and will insist that the services of only adequately trained metallurgists shall be secured.

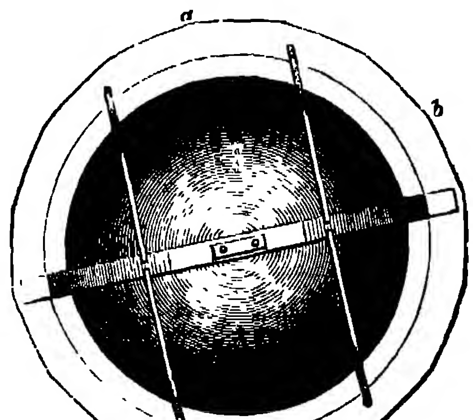
I shall have to direct your attention to the minute care with which details affecting commercial interests are now investigated,[1] and your success will further depend on the facility with which you are able to use the "tools of thought" furnished by chemistry, physics, and mechanics Whether you will ever possess the tact and judgment necessary to direct such works as Dowlais with an army of ,10,000 people, obviously depends on personal qualifications which I can but little influence.

I venture to hope that you will, by original research, add to the general advance of science, for, as the late Prof Clifford has reminded us, what have often proved to be the most useful parts of science have been investigated for the sake of truth, and not for their usefulness

Dr Percy found metallurgy practised in this country mainly as an empirical art He may well feel, to borrow the words of an old writer, that in his hands "the business of metallurgy and essaying has not only been illustrated but also improv'd, amended, and enrich'd", for his works contain a record of its progress, his teaching and researches have secured it a scientific basis, and he has trained a body of scientific workers, in whose hands the immediate future of metallurgy to a great extent rests Bearing in mind how much the progress of our science means to England, I cannot but be conscious that, in attempting to continue this work, I undertake a grave responsibility.

ON AN EXPERIMENTAL ILLUSTRATION OF MINIMUM ENERGY[1]

THIS illustration consists of a liquid gyrostat of exactly the same construction as that described and represented by the annexed drawing, repeated from NATURE, February 1, 1877, p 297, 298, with the difference that the figure of the shell is prolate instead of oblate The experiment was in fact conducted with the actual apparatus which was exhibited to the British Association at Glasgow in 1876, altered by the substitution of a



←— 7 INCHES —→

shell having its equatorial diameter about $\frac{9}{10}$ of its axial diameter, for the shell with axial diameter $\frac{9}{10}$ of equatorial diameter which was used when the apparatus was shown as a successful gyrostat.

[1] *Phil Trans* 1866, p 438

[2] First Report of the Committee on the Hardening, Tempering, and Annealing of Steel, 1879

[3] "On the Structure of Cast Steel Ingots" Translated for the Institution of Mechanical Engineers by W Anderson, C E (1879)

[4] *Berichte der deutschen chemischen Gesellschaft*, 1879, No. xii 93 *Glaser's Annalen für Gewerbe und Bauwesen*, August, 1880, p 138

[5] Trève and Durassier, *Comp rend*, t lxxx. (1875), p. 799, Wattenhofen, *Journal* of the Iron and Steel Institute, 1879, No. 1, p. 305.

[6] Barus, *Phil. Mag* [5], vol viii p 341

[7] W H Johnson, *Chemical News*, vol. xlii (1880), p 70.

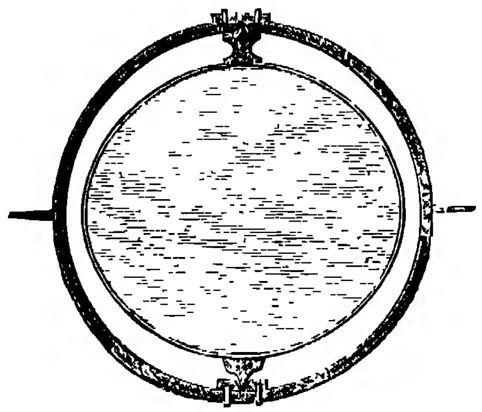
[8] V. Deshayes, "Classement et Emploi des Aciers" (Paris, 1880), also *Bull* Chem. Soc. tom. xxxi (1879), p. 160

[1] In illustration of this see an exhaustive mathematical paper on the values of iron ores, by Prof A Habets *Cuyper's Revue Universelle des Mines* (1877), t 1 p 504

[1] By Sir William Thomson, F R S British Association, Swansea, Section A.

The oblate and prolate shells were each of them made from the two hemispheres of sheet copper which plumbers solder together to make their globular floaters. By a little hammering it is easy to alter the hemispheres to the proper shapes to make either the prolate or the oblate figure.

Theory had pointed out that the rotation of a liquid in a rigid shell of oval figure, being a configuration of maximum energy for given vorticity, would be unstable if the containing vessel is left to itself supported on imperfectly elastic supports, although it would be stable if the vessel were held absolutely fixed, or borne by perfectly elastic supports, or left to itself in space unacted on

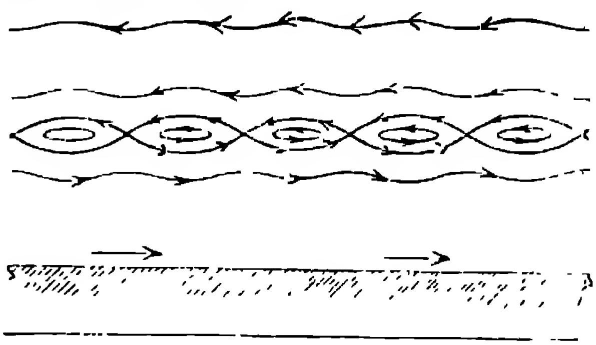


by external force; and it was to illustrate this theory that the oval shell was made and filled with water and placed in the apparatus. The result of the first trial was literally startling, although it ought not to have been so, as it was merely a realisation of what had been anticipated by theory. The framework was held as firmly as possible by one person with his two hands, keeping it as steady as he could. The spinning by means of a fine cord[1] round a small V pulley of ½-inch diameter on the axis of the oval shell, and passing round a large fly-wheel of 3 feet diameter turned at the rate of about one round per second, was continued for several minutes. This in the case of the oblate shell, as was known from previous experiments, would have given amply sufficient rotation to the contained water to cause the apparatus to act with great firmness like a solid gyrostat. In the first experiment with the oval shell the shell was seen to be rotating with great velocity during the last minute of the spinning, but the moment it was released from the cord, and when, holding the framework in my hands, I commenced carrying it towards the horizontal glass table to test its gyrostatic quality, the framework which I held in my hands gave a violent uncontrollable lurch, and in a few seconds the shell stopped turning. I saw that one of the pivots had become bent over, by yielding of the copper shell in the neighbourhood of the stiff pivot carrying disk, soldered to it, showing that the liquid had exerted a very strong couple against its containing shell, in a plane through the axis, the effort to resist which by my hands had bent the pivot. The shell was refitted with more strongly attached pivots, and the experiment has been repeated several times. In every case a decided uneasiness of the framework is perceived by the person holding it in his hands during the spinning; and as soon as the cord is cut and the person holding it carries it towards the experimental table, the framework begins, as it were, to wriggle round in his hands, and by the time the framework is placed on the table the rotation is nearly all gone. Its utter failure as a gyrostat is precisely what was expected from the theory, and presents a truly wonderful contrast from what is observed with the apparatus and operations in every respect similar, except having an oblate instead of a prolate shell to contain the liquid.

[1] Instead of using a long cord first wound on a bobbin, and finally wound up on the circumference of the large wheel as described in NATURE, February 1, 1877, p. 297, I have since found it much more convenient to use an endless cord little more than half round the circumference of the large wheel, and less than half round the circumference of the V pulley of the gyrostat, and to keep it tight enough to exert whatever tangential force on the V pulley is desired by the person holding the framework in his hand. After continuing the spinning by turning the fly-wheel for as long a time as is judged proper, the endless cord is cut with a pair of scissors and the gyrostat released.

ON A DISTURBING INFINITY IN LORD RAYLEIGH'S SOLUTION FOR WAVES IN A PLANE VORTEX STRATUM

IN the paper in last week's NATURE under this heading by Sir William Thomson, the lower part of the illustration was inadvertently turned round at the last moment by the printer, the cut should stand as follows:—



SARGASSUM[1]

THIS paper opens with a discussion of the value of the species *Sargassum bacciferum*, the particular species of this genus which is well known as the Gulf-weed. The author considers that the floating plants to which this name has been given are simply fragments of many varieties or species of Sargassum, more particularly of *S. vulgare*. In support of this view he points out that, from the accounts of nearly all authors who have examined specimens, it appears that the lower part of the stem had been broken across, and that it is therefore fair to conclude that they belong to plants which are rooted under ordinary circumstances. This conclusion had been already arrived at by Rumphius, C. Agardh, Rennell, Humboldt, and more recently by G. von Martens, but of these writers Rennell and Humboldt are of opinion that the floating fragments continue to grow, and in this they agree with Thunberg, Meyen, and Harvey. Dr. Kuntze contends that there is not sufficient evidence forthcoming to establish the correctness of this view. He urges that, even admitting that some growth takes place, it is only temporary, and that it therefore affords no ground for regarding these as pelagic plants. The only other cases of growth of Fuci when floating are offered by *Macrocystis pyrifera* (Sir Joseph Hooker, "Flora Antarctica," vol. i.), and by *Fucus vesiculosus* (Mr. Moseley, "Notes by a Naturalist on the *Challenger*"), and doubtless Dr. Kuntze's objections apply to these also. The question naturally arises as to whether these floating plants are actively living, or are dying, or dead.

In the case of Sargassum Dr. Kuntze considers that their bright yellow colour is due to changes taking place, either preliminary to or in consequence of death, in the brown colouring-matter of the attached forms to which he believes the floating fragments belong. Mr. Moseley, however, is of opinion that this is the natural colour of these plants whilst living. It does not appear that any such difference in colour has been noticed in attached and floating specimens of Macrocystis or of Fucus, and this is a fact which is not in harmony with Dr. Kuntze's views respecting Sargassum. Again, the general observation that these floating Fuci have no reproductive organs offers a further difficulty which they do not explain. Dr. Kuntze endeavours to meet the difficulty by stating that he has found receptacles occasionally in free-swimming individuals, and he gives figures of two plants bearing them, but neither from the figures nor from his account of them is it possible to conclude with certainty that the bodies in question are really of a reproductive nature; and he explains the usual absence of these organs in the floating individuals by suggesting that the receptacles, being the most fragile parts of the plant, are the most readily destroyed, and further that, owing to the small number of air-chambers with which they are provided, they would sink on becoming detached. In this case, as in that of the colour, these explanations respecting Sargassum will only become valid when they are found to hold good of Macrocystis and of Fucus also. It is apparent that the

[1] "Revision von Sargassum und das sogenannte Sargasso-Meer." Von Dr. Otto Kuntze (*Engler's botanische Jahrbücher*, Bd. I. Heft iii., 1880) Leipzig, Engelmann.)

evidence offered in support of Dr. Kuntze's views is at present incomplete, and that further researches into the life-history of these plants must be made before these views can be generally accepted.

After an elaborate systematic revision of the genus, Dr. Kuntze goes on to discuss the Sargasso Sea He draws attention to the wide divergences which exist between the accounts given of it by different travellers Thus Humboldt and Maury speak of it as a mass of gulf-weed having an area of thousands of square miles, whereas others—Sir Wyville Thomson, for instance—describe it as consisting of small scattered patches. Dr Kuntze concludes that there is no reason for assigning a definite and constant area to it It appears that the patches of weed occur more frequently in the region of calms, but at times it is either absent or present only in small quantities even there. A wind blowing for a considerable time in one direction might, under certain circumstances, cause the aggregation of patches into a mass of some extent, such as is to be found, for instance, in the neighbourhood of the Bermudas in spring after the equinoctial gales, but even this would be but small when compared with Humboldt's estimate

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The following gentlemen have been nominated by the Vice-Chancellor as examiners for the Degree of Bachelor of Medicine In the first examination for M B. —S H. West, M A , M.B Christ Church, J. A Dale, M A. Balliol, A G Vernon Harcourt, M A Christ Church In the second examination for M.B —T. K. Chambers, M D , Christ Church , James Andrews, M.D , Wadham , T. P Teale, M.A , M B , Brasenose. In the examination in Preventive Medicine .—W Ogle, M D. Corpus , G W Child, M D. Exeter , W. F Donkin, M A. Magdalen ; Douglas Galton, Capt. R.E , Hon. D.C L

A Fellowship will shortly be offered by University College for proficiency in biology The details are not yet announced.

SCIENTIFIC SERIALS

Annalen der Physik und Chemie, No 10 —On the influence of curvature of the wall on the constants of capillarity in wetting liquids, by P. Volkmann —Constructions for anomalous dispersion, by E. Ketteler.—On Newton's dust rings (continued), by K Exner —On calculation of the correction for temperature in calorimetric measurements, by L Pfundler.—Chemical energy and electromotive force of various galvanic combinations, by J Thomsen.—On the photo- and thermo electric properties of fluor spar, by W. Hankel —On electrical elementary laws, by E. Riecke.—Remarks on some recent electro-capillary experiments, by E. Lippmann.—Experimental researches on weakly magnetic substances (third part), by P. Silow.—Researches on the height of the atmosphere and the constitution of gaseous heavenly bodies (continued), by A. Ritter.—Reply to Herr Herwig "On the Heat-Conductivity of Mercury," by H F. Weber —Reply to Herr Winckelmann's remarks in a recent number, by the same

Archives des Sciences Physiques et Naturelles, October 15.—Contributions to a study of the colouring-matters of plants, by J. B. Schnetzler.—Practical study of marine zoology , the zoological station of Naples, by E Yung —Sixty-third session of the Helvetic Society of Natural Sciences, held at Brigue on September 13-15, 1880; Proceedings in the departments of Physics and Chemistry, Geology, Botany, Zoology and Medicine.

SOCIETIES AND ACADEMIES

LONDON

Linnean Society, November 4.—Prof. Allman, F.R S., president, in the chair —The session opened by Mr H. C. Sorby showing drawings of some British sea-anemones, with habitat on the upper fronds of long seaweeds in deep water , and he recorded having seen a solitary cream-coloured cetacean on the English coast —Mr. Arthur Bennett drew attention to a new British Chara (*C. stelligera*), remarkable for the presence of stellate bulbils on the stems.—Mr. E M. Holmes exhibited two marine algæ new to Britain, viz., *Dasya gibbesii*, from Berwick-on-Tweed, and *Ectocarpus terminalis* from Weymouth ; and also species of *Callithamnion*, with antheridia and trichophore on the same branchlet.—Prof. T. S. Cobbold exhibited a remarkable trematode from the horse. It was discovered by Dr. Sonsini at Zagazig during the Egyptian plague, with which outbreak, however, the parasite had no necessary connection The worm (*Gastrodiscus sonsinonis*) appeared to be an aberrant amphistome furnished with a singular ventral disk, whose concavity was lined with about 200 small suckers having a tesselated aspect In this respect its nearest approach was a worm infesting a genus of spinny finned fishes (*Cataphractus*) belonging to the Triglidæ. According to Prof. Leuckart's recent anatomical investigation, however, doubts are thrown on its amphistomoid affinities —Mr G F Angas showed the leaf of *Hermas gigantea*, an umbelliferous plant of the Cape used as tinder by the Hottentots —Mr E A Webb exhibited a monstrous bramble (*Rubus fruticosus*) with flowers represented by elongated axes covered with minute pubescent bracts and apices fasciated.—A communication by Dr G. Watt was read, viz , contribution to the flora of North-West India. The geographical features of the district are noted. He divides it into three areas the first range, Ravee-Basin, with magnificent forests of *Cedrus deodara* on its northern slopes, has on the southerly ones vegetation with an Indian facies, being barely outside the humid influence of the tropical rains of the plains , the second range, comprising Pangi, Lower Lahore, and British Lahore, has a flora altogether changed, dry short summers and snow-clad mountains giving a climate and plant-life of quite a different cast , the third range evinces still further change of flora, this assuming a Thibetan type Some 300 species of plants are noted, four being new.—A paper on the Papilionidæ of South Australia, by J. G Otto Tepper, was read The butterflies of this part of Australia are comparatively few in numbers, and sombre colours prevail thus seemingly in harmony with the surroundings of their habitat. The paucity of numbers the author attributes to the dryness of the climate. Notes on the habits accompany the descriptions of the species —Notes on a collection of flowering plants from Madagascar were read by Mr. J G Baker. The flowering plants are less known than the ferns from this interesting island ; two new genera are denoted, viz. (1) *Kitchingia*, belonging to the Crassulaceæ, a succulent herb with fleshy sessile leaves and large bright red flowers in lax terminal cymes , (2) *Rodocodon*, a liliaceous plant with red flowers and peculiar spurred bracts it comes between *Muscaria* and *Urginea* Thirty new species are described.—Messrs. Edw. Brown, H F Dresser, and T. P Pippe were elected Fellows of the Society.

Mathematical Society, November 11 —Mr. C. W Merrifield, F.R.S., president, in the chair.—The Treasurer's and Secretaries' reports were read and adopted.—After the ballot had been taken, the gentlemen whose names are given on p 614 of the last volume were declared duly elected as the Council for the present session —Mr S Roberts, F.R S , the new president, having taken the chair, Mr. Merrifield read his valedictory address, "Considerations respecting the Translation of Series of Observations into Continuous Formulæ "—On the motion of Prof Cayley, F R S., the address was ordered to be printed in the *Proceedings*.—Mr H M. Jeffery, F R S , then read a paper on bicircular quartics, with a triple and double focus, and three single foci, all of them collinear —Mr Tucker (hon. sec) communicated parts of a paper by the Rev. C. Taylor, further remarks on the geometrical method of reversion.

Geological Society, November 3.—Robert Etheridge, F R.S , president, in the chair —Bernard Barham Woodward was elected a Fellow of the Society.—The President announced that the original portrait of Dr William Smith, painted by M. Fourau in the year 1838, had been presented to the Society by Mr William Smith of Cheltenham.—The following communications were read :—On the serpentine and associated rocks of Anglesey, with a note on the so-called Serpentine of Porthdinlleyn (Caernarvonshire), by Prof. T. G. Bonney, F R S , Sec G.S. Several patches of serpentine are indicated on the Geological Survey map on the western side of Anglesey, near Tre Valley Station, and a considerable one on Holyhead Island, near Rhoscolyn. These really include three very distinct varieties of rocks : (1) compact green schistose rocks, (2) gabbro, (3) true serpentine. The author described the mode of occurrence of each of these, and their relations, the serpentine being almost certainly intrusive in the schist, and the gabbro in the serpentine. The microscopic structure of the various rocks was described in detail, especially of the last. It presents the usual characteristics, and is an altered olivine rock which has contained bronzite. One or two varieties are rather peculiar ; an ophicalcite and a compact chloritic schist containing chromite are also noticed

At Porthdinlleyn there is no serpentine, but a remarkably interesting series of agglomerates and (probably) lava flows of a basic nature, which may now be denominated diabases.—Note on the occurrence of remains of recent plants in brown iron ore, by J. Arthur Phillips, F.G.S. The fossilising ironstone described by the author occurs at Rio Tinto, in the province of Huelva, Spain, in close proximity to the celebrated copper mines of that name, where it forms a thick horizontal capping of a hill known as the Mésa de los Pinos. In this iron ore Dr Carruthers has identified the following vegetable remains:—Leaves and acorns of *Quercus ilex*, Linn , leaves and seed of a two-leaved species of *Pinus*, most probably *Pinus pinea*, Linn., the cone of *Equisetum arvense*, Linn., and a small branch of a species of *Erica*. There is also a well marked leaf of a dicotyledonous plant not yet identified. The plants are evidently all of the same species as are still found growing in Spain. The author attributes this deposit of ironstone to the decomposition, partly by organic agency, of ferruginous salts, derived from the oxidation of iron pyrites, which flowed into a marsh or shallow lagoon. Subsequently to this the valleys of the Rio Agrio and Rio Tinto were eroded, leaving the Mésa de los Pinos with its thick capping of iron ore.—Notes on the locality of some fossils found in the Carboniferous rocks at T'ang Shan, situated, in a north north-east direction, about 120 miles from Tientsin, in the province of Chih Li, China, by James W. Carrall, F G S , with a note by Wm. Carruthers, F.R S. The author described the locality from which he obtained some plant-remains of apparently Carboniferous age, and stated that mining operations had been carried on by a Chinese company in the district since the year 1878 Several seams of coal occur, varying in thickness from 11 inches to 6 feet Mr. Carruthers stated in a note that the specimens submitted to him belong to a species of *Annularia*, probably *A. longifolia*, Brough, abundant in the British coal-measures, and found both on the Continent and in North America.

PARIS

Academy of Sciences, November 8 —M. Edm Becquerel in the chair —The following papers were read —On the heat of formation of dimethyl, and on its relation with the methylic and ethylic series, by M. Berthelot —Researches on the Upper Cretaceous of the northern slope of the Pyrenees, by M Hébert.—Observations on phylloxera, by M Henneguy. From over three years' observations he is quite convinced that vines not attacked may be saved, and those which have not suffered too much be restored Vine growers have three efficacious modes of treatment: sulphocarbonates, sulphide of carbon, and submersion But the treatment must be repeated each year (at least for a time), and must extend over the whole vineyard. To destroy the winter egg in the bark, decortication and treatment with sulphide of carbons has proved good , also application of flame to the stock with a "pyrophore" (the latter is more effectual than application of boiling water, also easier and more economical). The spontaneous recovery of seemingly dead vines is only temporary , new roots form after abundant rain, and supply sap for fresh shoots. If the insects (which persist) be destroyed before they reach these roots, the vine may quite recover —Observations on the influence of last season on the development of phylloxera , on insecticides, by M. Boiteau August and September were so rainy as to be very unfavourable to the insect. Most of the vines that still exist will be saved. Sulphide of carbon is largely used by all kinds of proprietors. Among other directions as to its use, he says, the quantity per square metre should be 15 to 20 gr.—Preparation of a new alimentary substance, *nutricine*, by M. Moride Raw meat, freed from bones and tendons, is passed into suitable machines with nitrogenised alimentary substances (bread, *e g*), which absorb its water, and form perhaps organic combinations with it. The whole is dried in air or a mild stove, then pulverised and sifted The powder got is grey or yellowish, and has an agreeable taste. With albumen, fats, or gummed water, solid cakes or cubes may be made of it, to be afterwards divided for soups, sauces, &c. The substance is very nutritive, and keeps indefinitely if not exposed to moisture or too great heat.—The Secretary stated that a great many applications had been made for seeds of the vines of Soudan. M. Lécard has published a *brochure* on this vine, and is collecting all the seeds he can to send home.—On algebraic equations; examination of the propositions of Abel, by M. West.—Researches on the transformation of oxygen into ozone by the electric *effluve* in presence of a foreign gas, by MM. Hautefeuille and Chappuis. Even a very little chlorine hinders the transformation, and when introduced destroys ozone previously formed. Nitrogen occasions a larger transformation than if the oxygen were unmixed, and had the same pressure as in the mixture. The formation of ozone in presence of hydrogen is greater than in that of nitrogen. With fluoride of silicium a large proportion of ozone is formed (the *effluve* becoming a luminous rain of fire). The authors theorise on these results.—Action of chlorine and hydrochloric acid on chloride of lead, by M. Ditte.—On the combinations of ammonia gas with chloride and iodide of palladium, by M. Isambert. The tensions of dissociation are weaker at the same temperature the greater the heat of combination.—On the formation of chloroform by alcohol and chloride of lime; equation of the reaction and cause of the liberation of oxygen manifested, by M. Béchamp. *En résumé*, the chloroform is produced without liberation of gas; the swelling is due exclusively to the chloroform, which is in a medium the temperature of which is higher than its boiling point, and to the tension of its vapour; the gaseous liberation only commences when it has completely distilled, and the temperature rises so as to reach that which is necessary to make the mixture of chloride of lime and water boil.—On the organisation and the development of the Gordians, by M. Villot.—M. de Treux described a bolide observed at Amiens on November 2, at 4 58 p m. Its diameter seemed about a sixth of that of the moon. Visible 10 to 15 sec the bolide was successively blue, yellow, and red , bright sparks being given out at each change of colour.—A geological map of Spain, by M. de Botella, was presented.

VIENNA

Imperial Academy of Sciences, November 4.—On the theory of so called electric expansion or electrostriction, by L. Boltzmann.—Measurements of co-vibration for the case of strong deadening, by C Laske.—On cells and intermediate substances, by S. Stricker.—The psychic activity of the coating of the brain, considered from a physiological standpoint, by L Schneeder.—Description and sketch of a steerable balloon, by W. Bosse.—On mesitylendisulpho-acid, by J Barth and T Herzig.—On the absorption of solar radiation by the carbonic acid of our atmosphere, by E. Lecher.—On some properties of the capillary electrometer, by J. Hepperger.

November 11 —On the Tsubra deer (*Cervus Ludorffii*, Bohlan), by L. T Fitzinger.—On the question as to the nature of galvanic polarisation, by F. Exner.—On the latent heat of vapours, by C. Puschl.—Theory of acceleration-curves, by F. Wittenbauer —On derivatives of cinchonin acid and of chinolin, by H. Weidel and A. Cobenzel —On croton-aldehyde and its derivatives, by A. Lieben and T. Yeisel.—On reduction of croton chloral, by the same.

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THURSDAY, NOVEMBER 25, 1880

SULPHURIC ACID AND ALKALI

On the Manufacture of Sulphuric Acid and Alkali. By George Lunge, Professor of Technology in the Zurich Polytechnic School, formerly Manager of the Tyne Alkali Works, South Shields. Vol. ii. (London: Van Voorst, 1880.)

THIS volume forms a fitting sequel to the first volume of Prof. Lunge's valuable work (noticed in NATURE, vol. xx. p. 263) on the alkali manufacture. The praise we bestowed upon the earlier volume may without stint be applied to this. Clearness and conciseness in style remarkable in a foreigner, accuracy and fulness in the description of both old and new processes, and admirable woodcuts of apparatus and manufacturing plant, constitute the chief merits of this by far the best treatise extant on the most important branch of chemical industry. The value of works on technical science, as well, we may also add, of the teaching of such subjects, depends not only on a sound knowledge of the scientific principles upon which the manufactures are based, but likewise upon a thorough acquaintance with technical minutiæ and the special details of construction and operation, the due observation of which is necessary for the manufacturer's success. Either one of these conditions may be fulfilled by a host of authors, but to find both fully developed, as is the case with Prof. Lunge, is rare. Manufacturers themselves, many of whom may be fully competent to the task, are, for obvious reasons, not given to make known the details of their successful manufacture. Nor is the professional chemical engineer likely to do more than describe the most common and well-known processes. Dr. Lunge enjoys the great advantage of having had manufacturing experience, if not along the whole line, at least over a very large portion of his subject; and to this he now adds that of a position in which every motive urges him to impart his knowledge unreservedly to his readers.

A criticism worth having of a book like the one under review should by good rights imply a knowledge of manufacturing detail at least comparable with that of the author. To this the present writer can lay no claim, whilst mere indiscriminate praise is a mode of treatment to which he would not subject the readers of NATURE, either for their sake or for his own. In order therefore to find out how far this work really teaches what it professes to teach, how far it is abreast of the improvements of the day, and how far it expresses a sound opinion on vexed trade questions such as "open" as against "closed" salt-cake roasters, or as Hargreaves salt-cake process as against the old Leblanc's process, the writer has called to his assistance his friend and former pupil, Mr. John H. Crossley of Widnes, in whose ability in both the theoretical and practical side of the subject he has the greatest confidence, and to whom he is indebted for an opinion on these questions.

The opening chapters of the volume are devoted to a discussion of the various methods of making salt-cake or sodium sulphate the first great step in the production of alkali from common salt. It is a fact worthy of note that although Leblanc's process had been in successful work in France from the year 1797, seventeen years elapsed before this was taken up in England at Walker-on-Tyne by Losh. This may be perhaps accounted for by the war then raging by which communication between the two countries was almost entirely cut off, but especially because of the high war duty on salt, which in 1805 amounted to no less than 30*l*. per ton, and which existed up to the year 1823! This may be regarded as the year of birth of the manufacture on a large scale, and in this year James Muspratt, whom we are glad still to be able to salute as the veteran founder of the alkali trade, erected works at Liverpool, where common salt was decomposed with sulphuric acid and the Leblanc process carried out completely. The difference in cost of production in the early part of the century and in recent years is seen by the fact that in 1814 soda crystals cost 60*l*. per ton, whilst in 1861 the price was 4*l*. 10*s*.

Dr. Lunge goes into the question of "Close" *versus* "Open" salt-cake roasters pretty fully, but deriving his practical experience from Newcastle, where open furnaces are almost exclusively employed, it is not surprising to find a leaning towards the latter form betrayed in spite of his attempt to place the matter before his readers in an impartial manner. One of his arguments in favour of open roasters is that stronger sulphate is obtained by their use; he says (p. 93) "Owing to the higher temperature of an open roaster it is much easier to calcine the salt-cake and to decompose the common salt completely. In blind furnaces this can only be obtained by employing a large area and consequently a very thin layer of material and spending a good deal of time over the calcining process. This of course is much easier with furnaces possessing two muffles to one pan."

Against this fact it may be mentioned that though the Lancashire close roasters are certainly built larger than the Newcastle open ones, a much larger charge is worked, and many works regularly turn out salt-cake testing above 97 per cent., and this too in furnaces with one muffle only, the double form he speaks of and figures on pp. 72 and 90, being certainly represented in practice by one or two isolated specimens only.

Dr. Lunge (p. 116) gives 14–15 cwt. as usual charges of salt for close roasters, but as much as 18 cwt. are frequently worked at one operation. In this same question the author hardly gives due prominence to the "Plus Pressure" system, which is now doing good work with regard to close roasters. Probably the appendix to be published with vol. iii. will deal with this.

The description (pp. 115–125) of the actual working of a salt-cake furnace is very good indeed.

Chapter IV., on Hargreaves' Process, is also excellent, and is probably the best description extant; the only fault that could be found is that the figures show a double line of cylinders separated by an arch, the idea being to allow of having a drawing-door on each side of the cylinders. This however is not by any means compensated for by the greater loss of heat by radiation. Only the earlier plants are built this way, the more modern erections having the cylinders built back-to-back so as to form one solid block.

Dr. Lunge wisely refrains from much speculation as to the future of this most ingenious process. "If we are to

pronounce finally upon the prospects of this process," he says (p. 158), "we shall not find this quite an easy task. A few years ago English alkali-makers had such a high opinion of that process that no new vitriol chambers were built, and the question was discussed whether it was more worth while to work down the existing chambers, or to defray the cost of the new plant at once. Afterwards a less sanguine opinion gained ground, and it seemed as if Hargreaves's process would again be put into the background." At the present moment the writer believes that the outlook for the Hargreaves process is more favourable than ever

Chapters V and XII, on the Cost of producing Sulphate and Soda-ash, can only serve to give an approximate idea of the matter. The exact cost involved is not readily imparted by manufacturers, and is moreover governed by local circumstances, such as the current price of labour, &c.

The latter half of the volume is concerned with the second stage in the manufacture of alkali known as the black ash process In this the salt-cake is heated with limestone and coal, the resulting carbonate of soda being removed by lixiviation from the insoluble alkali makers' waste The first part of the chapter on Hand Furnaces appears to be very complete, and the figures on the plate facing p 386 are correct and well-drawn This can hardly be said of that portion relating to the modern revolving furnaces, this is probably the weakest part of the book, the author having apparently had no practical experience on this point. Figures of two revolvers are given; of these Fig 182 may be said to represent a fairly good design, though one single wide evaporating pan is considered more convenient for repairs than two narrow ones. As regards the speed of revolution (p 411) Dr. Lunge is a little out He says the revolver gearing must be capable of giving speeds of one revolution in four minutes to five revolutions in one minute, "usually the highest velocity does not exceed one revolution per minute" Those figures are not correct for the present style of working Revolvers should be able to go a good deal slower, but speeds as high as seven to eight revolutions per minute should always be possible, especially when working the Pechiney-Weldon process, when the after charge has to be very well and rapidly mixed through the rest. This can hardly be obtained when the large spin-wheel on the revolver is worked from a worm-wheel as Dr. Lunge describes, a pinion-wheel should be used. The author (p 406) says, "Leaving aside the older constructions of revolving furnaces, we shall only describe two of the most modern" The first of these has been spoken of above, the second, figured pp 414 and 415, a revolver fired by gas, was erected at one works only in 1870, and was found to be a failure, after running a year or two it was entirely reconstructed to burn fuel. Since then the mechanical bogies and engine gearing have been completely altered, so that the figures can hardly be said to represent one of the "most modern constructions"

Regarding chimney power Dr. Lunge says (p. 412) that usually every two revolvers have a chimney 6 feet diameter and 100 feet high to themselves. This is certainly not sufficient for the most economical working; to stint a revolver of draught is a serious mistake.

On another point in the black-ash process Dr. Lunge's opinions do not tally with those of Lancashire manufacturers. A few years ago Mr. Mactear of St Rollox proposed a plan of adding from 6 to 10 per cent. of lime to the black-ash in excess of that usually worked. This apparently simple process was believed by some likely to work wonders, and statements were made as to the actual gain of many thousands of pounds per annum in a single works by its adoption. Dr. Lunge gives more credit to this than some of our Lancashire friends seem inclined to do.

The remaining processes in the great suite of chemical changes involved in the alkali trade are as thoroughly discussed by Dr. Lunge as those which have now been noticed. Divergent views concerning many details of these may doubtless be held by various manufacturers, but all will agree in the opinion not only that this is an excellent book, but that it would be very difficult for any one to write a better one.

H. E. Roscoe

THE FLORA OF PLYMOUTH

Flora of Plymouth an Account of the Flowering Plants and Ferns found within Twelve Miles of the Town, with Brief Sketches of the Topography, Geology, and Climate of the Area and History of Local Botanical Investigation. By T R. Archer Briggs, F.L S With Map 8vo, pp. xxxv. and 432. (London. Van Voorst, 1880)

THIS is a model local flora Mr. Briggs is well known as one of the most experienced and trustworthy amongst the botanists who have made a special study of British Phanerogamia He has established a claim upon the gratitude of his fellow-workers by acting for several years as the honorary distributor of their Exchange Club, and in this capacity has received and sent out many thousands of specimens The present work is the result of the rambles of twenty years, and as he has restricted its limits to a radius of twelve miles from the town, the whole of the district has been within walking distance of his home, and it is probable that there is no tract in Britain of which the plants have been worked out and placed on record in such a thorough and exhaustive manner. A radius of twelve miles from Plymouth includes a great variety of soil and situation There are the maritime plants of the seashore and the tidal reaches of the Tamar and its affluents. Inland there are in the low country besides the stream-sides, meadows, and cultivated fields, plenty of woods and deep shady lanes with high banks and thick hedgerows, and the twelve miles radius reaches to a height of 1,700 feet on Dartmoor, and includes a considerable space of open uncultivated heathy and swampy ground. The district is not rich in limestone nor in ponds, but except in the plants which affect these two kinds of station there is full scope so far as situation goes to suit all their varied requirements in habitat.

Out of the 1,680 species enumerated in the last edition of the London Catalogue 873, or considerably more than half, are found within the radius covered by this book. Out of these 728 are natives, and the other 145 more or less certainly introduced by human agency.

It is interesting to have an area so far west in the island so thoroughly worked out, and certainly one of the most instructive points in connection with the matter is to note which British plants fail to reach and become very rare within the area. Taking the species according to their types of distribution as classified by Mr. Watson in the fourth volume of his "Cybele Britannica," and adopting the more stringent scale of species-limitation which he there follows, we find that out of 1,425 British species 764 grow in the neighbourhood of Plymouth. The 120 species of Watson's highland or extreme northern type and the 49 local or doubtful species are not represented here at all. Of the eighty-one species of his Scottish type we get only 5, and out of the 37 species of his intermediate type only 3 enter into the Plymouth area. So that the boreal element of the British flora, 238 species, is represented at Plymouth only by 8 species, such plants as *Rubus saxatilis*, *Gnaphalium dioicum*, *Polypodium Phegopteris*, *Polypodium Dryopteris*, and *Lycopodium Selago* lurking in very small quantity in the recesses of Dartmoor. Of Watson's 70 Atlantic or specially western species Plymouth has 36; of Watson's 127 Germanic or specially eastern species Plymouth has only 16, of the 532 species spread almost universally through Britain Plymouth has 484. Perhaps the most noteworthy point of all is that of Watson's 409 plants of the English type of distribution, plants spread widely through England, but running out in a northern direction north of the Humber and in the Scotch Lowlands, Plymouth gets only 220, or little more than half. Amongst the absentees in widely-spread English plants, for instance, are the common Forget-me-not (*Myosotis palustris*), the Mistletoe, *Genista tinctoria*, *Veronica Anagallis*, *Glyceria aquatica*, and *Scirpus lacustris*; and amongst the great rarities the common harebell (*Campanula rotundifolia*), the cowslip, the common butter-bur, *Hieracium boreale* and *vulgatum*, and some of the common south-country weeds, like *Solanum nigrum* and *Mercurialis annua*, which round about London are exceedingly plentiful. In the critical genera of British plants Plymouth is rich in rubi and roses, very poor in willows and hieracia. Amongst the rarities of the neighbourhood are *Polycarpon tetraphyllum*, *Eryngium campestre*, *Pyrus Briggsii*, a curious pear with fruit like that of a small crab-apple, *Physospermum cornubiense*, and two species of *Hypericum*, *bæticum*, and *linariifolium*, and it produces some curious hybrid epilobia and rumices.

The area is divided into five districts, founded on river-drainage, two of which are in Cornwall and three in Devonshire, and under these the special localities of the species are carefully traced out, the abundance in which each occurs being particularised, and the claims of each to be regarded as wild being in all doubtful cases carefully investigated.

As stated in the title, the book includes a map and short sketches of the climatology and geology of the district, and of the progress of botanical investigation within its bounds from the days of Lobel and Parkinson down to the present day. We can recommend it with confidence to all our readers who are interested in geographical botany as one of the most complete, conscientious, and interesting works of its kind that have ever appeared.

OUR BOOK SHELF

Peruvian Antiquities. The Necropolis of Ancon in Peru. A Series of Illustrations of the Civilisation and Industry of the Empire of the Incas. Being the Results of Excavations made on the Spot. By W. Reiss and A. Stubel. (London: Asher and Co., 1881.)

A FIRST instalment now lies before us of this magnificent undertaking, which, if fully realised, bids fair to rival in scientific interest and typographical splendour Lord Kingsborough's great work on Mexican Antiquities. Reserving a full notice for a later stage of the project, it will suffice here briefly to indicate its main features, and direct attention to its paramount importance for antiquarian and ethnological studies. The authors, who have lately returned from South America laden with archæological treasures of all kinds, have been encouraged by the munificence of the directors of the Berlin Royal Museum to place the results of many years' diligent research at the disposal of the public. Under the general heading of "Peruvian Antiquities" the publishers, Messrs. Asher and Co., of Berlin and London, propose to issue simultaneously in English and German a series of folio volumes illustrating the whole field of the ancient Quichua-Aymara culture, such as it existed at the time of the Spanish invasion. The publication will spread over a number of years, each volume appearing in separate parts varying in number according to the nature of the subject. Each part will contain a number of chromolithographic engravings with corresponding pages of explanatory text. These illustrations, which of course are the great feature of the work, will be produced in the most finished style of modern typographic art, and will consist of perfect facsimiles either in natural or reduced size of every conceivable object associated with the ancient civilisation of the Incas. The series begins with a volume devoted entirely to the "Necropolis of Ancon," now an obscure watering place and fishing village on the Peruvian coast, a little north of Lima, but in pre-Spanish times evidently the centre of a thickly-peopled district that had long been occupied by a settled population. The "finds" made in the mummy graves of this burial-place are of extraordinary archæological interest, illustrating in the most vivid manner every aspect of the social and domestic life of the ancient Peruvians. The volume is to be completed during the course of the ensuing two years in ten uniform parts, as above described, and to judge from Part I., which has just appeared, it is likely to prove of the utmost value to the antiquary and ethnologist. But our remarks on all details must be postponed till this volume is completed. The English text has been entrusted to Mr. A. H. Keane, whose special knowledge of the subject must ensure accuracy in the descriptive and explanatory part of the work.

Exposé Historique concernant le Cours des Machines, dans l'Enseignement de l'École Polytechnique. 23 pp. (Paris: Gauthier-Villars, 1880.)

THE council for the improvement of the course of study at the Polytechnic School has for some time had under consideration a revision of the *Programme d'Instruction* of the two years' course, and at different times, for instance in 1865, steps have been taken with a view to their improvement, but, according to this pamphlet, different circumstances, especially in 1870, have deferred the realisation of such schemes. Upon such a wide subject our author does not venture, but he confines himself merely to that part which relates to the *Cours de Machines*. We are indebted for this very interesting and full historical sketch of the matter from the very foundation of the school to the veteran geometer, M. Chasles.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Fertilisation of Yucca

IN NATURE, vol. xxii. pp 606, 607, appears a letter to which my attention has only to-day been called—signed E. L. Layard—on the subject of the fertilisation of yuccas successfully introduced and cultivated in New Caledonia.

The writer shows himself to be under some misapprehension as to the generic characters and appearance of the insect which is generally credited with the fertilisation of these plants in their native country. The moth of the genus *Pronuba*, to which he refers, is not a "large moth having yellow under-wings." Although a common species belonging to the *Noctuidæ*, standing in our British lists under the genus *Triphæna* (Ochs), but included in Dr Staudinger's European Catalogue in the genus *Agrotis* (Ochs), is distinguished by the specific, not generic, name *pronuba* (Lin.), as well as by the characteristic appearance to which your correspondent evidently alludes.

The genus *Pronuba* (Riley) was founded for the reception of *Pronuba yuccasella* (Riley) (see *Proceedings* Acad Sci Missouri, ii pp 55, 333; *Report* Nox Ins Missouri, v 151, vi. 131, *Canadian Entomologist*, iv 182, Hayden's *Bulletin* of the U S. Geological and Geographical Survey, iii. 121-141, &c), which has also been described by Prof Zeller in the *Verhandlungen der zoologisch-botanischen Gesellschaft in Wien*, 1873, vol xxiii. pp. 232, 233, under the name *Tegeticula alba*.

This small white moth, of which some varieties have a few black dots on the fore wings, belongs to the Lepidopterous group *Tineina* (Stn), possibly to the family *Hyponomeutidæ*. Prof Riley finds that the female, which has the basal joints of the maxillary palpi developed into a long curved tentacle furnished with spines, uses these appendages to collect and convey the pollen of the yucca to the tube of the stigma, which it could not otherwise reach, the eggs are then deposited, and the larva feeds upon the fruit, subsequently hibernating and becoming a pupa on the earth. It would be most interesting to ascertain whether *Pronuba yuccasella* (Riley) has been introduced with the yucca into New Caledonia, or whether any other insect, either indigenous or not indigenous to North America, has been found to take its place in carrying on the work of fertilisation. Prof. Riley considers the fact that yuccas introduced into the more northern portions of America have failed to produce seed may be attributed to the absence of *Pronuba*.

If Mr. Layard will direct his attention to this point he can scarcely fail to supply some valuable and instructive evidence bearing upon the subject. WALSINGHAM

Eaton House, Eaton Square, November 13

Skin Furrows of the Hand

ALLOW me to contribute the information in my possession in furtherance of the interesting study undertaken by your Japan correspondent (vol. xxii. p 605).

I have been taking sign manuals by means of finger-marks for now more than twenty years, and have introduced them for practical purposes in several ways in India with marked benefit.

The object has been to make all attempts at personation, or at repudiation of signatures, quite hopeless wherever this method is available.

(1) First I used it for pensioners whose vitality has been a distracting problem to Government in all countries. When I found all room for suspicion effectually removed here, I tried it on a larger scale in the several (2) registration offices under me, and here I had the satisfaction of seeing every official and legal agent connected with these offices confess that the use of these signatures lifted off the ugly cloud of suspiciousness which always hangs over such offices in India. It put a summary and absolute stop to the very idea of either personation or repudiation from the moment half a dozen men had made their marks and compared them together. (3) I next introduced them into the jail, where they were not un-needed. On commitment to jail each prisoner had to sign with his finger. Any official visitor to the jail after that could instantly satisfy himself of the identity of the man whom the jailor produced by requiring him to make a signature on the spot and comparing it with that which the books showed.

The ease with which the signature is taken and the hopelessness of either personation or repudiation are so great that I sincerely believe that the adoption of the practice in places and professions where such kinds of fraud are rife is a substantial benefit to morality.

I may add that by comparison of the signatures of persons now living with their signatures made twenty years ago, I have proved that that much time at least makes no such material change as to affect the utility of the plan.

For instance, if it were the practice on enlisting in the army to take (say) three signatures—one to stay with the regiment, one to go to the Horse Guards, and one to the police at Scotland Yard—I believe a very appreciable diminution of desertions could be brought about by the mere fact that identification was become simply a matter of reference to the records.

And supposing that there existed such a thing as a finger-mark of Roger Tichborne, the whole Orton imposture would have been exposed to the full satisfaction of the jury in a single sitting by requiring Orton to make his own mark for comparison.

The difference between the general character of the rugæ of Hindoos and of Europeans is as apparent as that between male and female signatures, but my inspection of several thousands has not led me to think that it will ever be practically safe to say of any single person's signature that it is a woman's, or a Hindoo's, or not a male European's. The conclusions of your correspondent seem, however, to indicate greater possibilities of certainty. In single families I find myself the widest varieties

15, St. Giles, Oxford, November 13 W. J. HERSCHEL

P.S.—It would be particularly interesting to hear whether the Chinese have really used finger marks *in this way*. Finger-dips (mere blots) are common in the East, as "marks."

The Aurora of the 3rd Instant

MR. E DOWLEN has kindly communicated to me some particulars of the above as seen by him at Southport

He first noticed the aurora at 6h 50m (it had however been visible before that time) as a greenish white glow on the north horizon. This gradually rose until 7h. 45m., when the top of the arch was estimated at two-thirds of the way up between the horizon and the Great Bear It then gradually died out from the ends of the arch, and at 8h. 30m had disappeared. During the time it was watched the following changes took place —

From 7h. to 7h 15m it faded away from the eastern end until 7h. 30m , when nearly half the arch was gone The western end then seemed to gather itself up somewhat, and to get brighter. After this the ends again lengthened out until 7h. 45m , when the whole began to fade away. At 7h. 25m a narrow-arched band of black cloud concentric with the auroral arch was formed. It seemed to start from the ends, and meet over the middle point. At first this lay close upon the aurora. It then rose quickly, passed through the Great Bear, and vanished. It took about ten minutes to form, rise, and disappear.

Mr. Dowlen saw no streamers, but faint ones might have been present and escaped notice owing to adjacent gas-lamps. The aurora was at no time bright, and Mr. Dowlen doubts whether any beyond the green line would have been seen in the spectroscope.

The cloud formation detailed seems to me of considerable interest. J. RAND CAPRON

Guildown, November 19

Temperature of the Breath

THERE is no doubt that Dr Roberts has discovered the true explanation of the phenomena that puzzled me and a good many others to whom I showed them. I have repeated Dr. Roberts's method of heating the enveloping material so as to expel all moisture from it, cooling it down to the temperature of the room and then breathing through it. In every case where I did so the thermometer showed a rise to 112° and upwards at the end of a minute; at the end of two minutes the index was pushed into the small bulb at the top, showing a temperature of about 116°. It is evident, therefore, that the high temperature observed is not the actual temperature of the breath, but is

caused by the caloric evolved by the transition of the aqueous vapour of the breath into the liquid or solid form.

Before seeing Dr. Roberts's explanation I referred the matter to the greatest living authority on heat, and he, after carefully repeating my experiments, was of opinion that the heat was produced by the compression of the air when forced through the material. Had he known of Dr. Roberts's simple but ingenious variation of the experiment there is no doubt he would have accepted Dr. Roberts's explanation. R. E. DUDGEON

November 18

THE following experiment may serve to supplement the observations of Dr. Roberts as to the cause of the high reading of a thermometer wrapped in a handkerchief and placed in the mouth. An ordinary non-registering thermometer was wrapped in about twelve folds of a dry linen handkerchief placed in the mouth, and the following readings taken at intervals of one minute — Inspiration was effected through the nostrils, expiration through the handkerchief The thermometer was in the mouth from the beginning to the end of the experiment. Temperature under the tongue before commencing, 37°·0 C. The reading of the thermometer wrapped as above described, one minute after introduction into the mouth, was 43°·0. At the end of the second minute, 44°·1, 3rd 42°·9, 4th 41°·2, 5th 39°·6, 6th 38°·2, 7th 37°·1, 8th 36°·9, 9th 36°·9, &c. After the experiment the temperature under the tongue was 37°·6. Capillarity is probably the chief cause of the rapid condensation of water, and the consequent liberation of heat in the dry fabric.

In connection with the above I may mention a schoolboy's trick, viz, gripping the arm of a schoolfellow with the teeth and breathing forcibly through his coat-sleeve. The sensation of heat thus produced is much greater than when the breath is allowed to impinge on the bare skin.

In conclusion, I must freely confess that Dr. Dudgeon completely upset my objection, as to compression of the bulb having anything to do with the high reading, by the experiments quoted in his last letter. F J M P.

Coral Reefs and Islands

IN my letter on "Coral Reefs and Islands," published in NATURE, vol. xxii. p. 558, I have just noticed an important slip in writing which demands correction.

In the third paragraph and ninth line, for *metres* read *miles*, so that the passage shall read thus: "On the Florida coast we have barriers with channels 10–40 *miles* wide"

More accurately, the space between the southern coast of Florida and the line of Keys (old barrier reef) gradually widens from a few miles in its eastern to more than 40 miles in its western part. The channel between the line of Keys and the present reef is 6–7 miles wide and about 150 miles long.

Berkeley, California, November 2 JOSEPH LECONTE

Vox Angelica

I HAVE received a letter from Mr. Samuel Ray of Stoke Newington with reference to my remarks on the Vox Angelica stop on an Estey American organ. Mr. Ray informs me that Gordon's supplementary tuning-valve is used for the desired effects. The *rationale* of the method is, that by partly closing the mute the reeds are flattened, just as one reed is when the key is partially depressed. Mr. Ray also says, that by pulling out the stop a little way and making the reeds beat the latter are liable to be drawn out of tune; but this was the original method, but is now improved upon. A separate mute is placed on the top of the tubes, so that the wind strikes one of the sets of reeds vertically, whereby undue strain is avoided.

GEORGE RAYLEIGH VICARS

Woodville House, Rugby, November 18

Fascination (?)

PROBABLY none of your readers have thought it worth while to make any comment on the letters on this subject which have recently appeared, because it would seem needless to discuss the *origin* of "fascination" by means of the eye of a snake (or whatever may be the stimulus to the alleged condition) while all the evidence we can obtain from these reptiles in confinement proves that the condition does not exist. It devolves upon those who might object to observations on reptiles in a glass case as untrustworthy, to show us why—all their other actions being normal—the prisoners should not exhibit the same habit in respect to this "fascination," as they are alleged to practise when free. It is rather late in the year now; but if Mr. L. P Gratacap will take the first opportunity of seeing snakes feed, and if any of your readers will pay a visit to the Zoological Gardens, both he and they will, I think, come to the conclusion that, beyond the expression of a little surprise (on the part of ducks and pigeons chiefly) which soon wears off at the sight of an *unfamiliar* object, both the birds and animals regard the snakes with marked unconcern. I have seen a guinea-pig, after finding no place of exit from the cage, quietly settle itself down in the midst of the coils of an Australian constrictor, shut its eyes and go to sleep Ten minutes afterwards the snake had moved, and the guinea-pig was washing its face with its paws. Not once, but a dozen times, a rabbit has nibbled the nose of a River Jack viper (*V. rhinoceros*) in a pretty, inquiring way, heedless of the strong blows the reptile would administer with its snout to the impertinent investigator of that queer-looking object. For fully ten minutes one day a rabbit sat gazing at the poised and threatening head of a puff adder, now and then reaching forward to smell the reptile's nose, and anon sitting on its hind legs to wash its ears, and again returning to the "fascinating" object of its inquiries If during that time the rabbit had fallen into the state of trance, it was so soon released from that condition as to be able to attend to its own comfort and busy itself about its toilet The birds show no more recognition than the other animals of the dangerous position in which they are placed We see them hopping about on the snakes and pecking lustily at their scales, sitting on the branches, preening their feathers and behaving themselves just as though no such dreadful (or pleasing?) sensation as "fascination" was possible!

I saw once a sparrow perched upon the body of a snake twisted round a branch, and preening itself. By-and-by a constrictor crept up slowly, touched the bird with its nose, and then threw the crushing folds around it. The deliberate approach of the snake and the unconscious attitude of the sparrow, concerned about its private affairs, would have staggered any ordinary believer in "fascination." I have closely watched the behaviour of snakes *intent* on feeding. It may be a sudden rush, when the victim has no time to see its enemy, or the gradual, lazy advance of the reptile, in either case the doomed victim betrays no suspicion of danger—at least so far as I have been able to ascertain after passing some hundreds of hours contemplating the snakes in the unequalled representative collection of the Zoological Society.

The expression in Mr Gratacap's letter, "glittering" eyes, applied to the orbits of a snake, which are veiled by the "antocular" membrane, and capable of very slight movement, may remind us of Virgil's "Suffecti sanguine et igni," and help to confirm the "basilisk" (not a snake, by-the-by) superstition, but can only serve to perpetuate a myth. Whatever may be the value of Mr. Foot's opinion, I would ask, "Who has ever seen a snake 'raise its tail' after the manner of the cats?"

Charles Darwin has much to say on this subject to any one who chooses to consult the "Origin of Species." He does not see any advantage in the cat's "waving" tail or the noise of the "rattle" of *Crotalus*, for no predatory animal would derive any benefit from a signal of warning to its prey. The snake certainly never "waves" its tail when intent on mischief.

ARTHUR NICOLS

Soaring of Birds

REFERRING to NATURE, vol. xxiii. p. 10, may I suggest the following?—The question seems to be: "How can birds, having attained a certain elevation, thence rise without further muscular effort?" If I am not in error in what follows, they can theoretically do so if they *start* with a difference between their horizontal velocity and that of the wind, and *end* with a less difference; *e.g.*, if they start at rest with respect to the earth, and end by drifting with the wind entirely.

Take this last case, and consider the earth as plane, and the wind as horizontal, and having a velocity $= v$ with respect to the [earth and] bird. Finally we suppose the bird gains a horizontal momentum $= mv$. Then, by conservation of horizontal momentum, the only force acting being vertical, the air must lose an equal horizontal momentum.

Now we know that in all cases of bodies colliding and ultimately acquiring the same velocity, while we have conservation

of momentum we have loss of visible kinetic energy, except when the coefficient of restitution = 1. This kinetic energy is transformed into the vibrational kinetic energy of sound and heat in general.

But cannot we have it partly transformed into potential energy by "soaring" against gravity? On this supposition we have the two laws, conservation of momentum where no forces act, and conservation of energy, holding But we have visible kinetic energy lost and *partly transformed into potential energy with respect to the earth*, partly (as usual) into vibrational kinetic energy of sound and heat. [The *sound* is evident in the "singing" of the wings]

It seems to me that the swooping referred to by your correspondent is only a matter of convenience to the bird, and does not really affect the mechanical question, and that the comparison to a kite (which is held by a string) is not very satisfactory. But from my own observation of sea-gulls I do not think one can say that all the manœuvres and turns of the bird in the air are performed without real muscular effort, though certainly without *flaps* of the wing, and if there be muscular effort there can be work done—against gravity in this case

The above is only a suggestion I wish to induce some more mathematical reader to write a clear answer on this interesting question W. LARDEN

Cheltenham, November 8

The Photophone

ON reading the description published in NATURE, vol. xxiii. p 15, of Prof Graham Bell's wonderful discovery, the transmission of speech by light, I notice that in "the photophone" the varying of the intensity of the beam of light thrown on the receiving instrument is accomplished by the simple and ingenious means of allowing the sound waves to beat on the back of a thin plane mirror It seems to me, however, that this arrangement is not complete, and is open to some objection As the plane mirror will, if provision be not made against it, become convex and concave alternately, it must, unless the vibrations be confined within very narrow limits, give in one vibration *two* periods of maximum and minimum illumination at the receiver, and therefore the received sounds, apparently, should be (assuming the periods between each maximum and minimum illumination to be of the same duration, which could never exactly occur) an octave higher than those transmitted This I think follows from the fact that the rays from the mirror would be dispersed not only when convex, but also when concave, *after* they had passed the focus If, therefore, the vibrations of the mirror are sufficiently great to bring its focus between the mirror and the receiving instrument, there would be a second point of minimum illumination. If however the mirror were made slightly convex, or were constrained by a spring or otherwise, this defect would be cured

Curiously enough, *theoretically* "the photophone" is the more effective the greater the distance between the transmitter and the receiver, as the degree of variation of the intensity of light falling on the selenium will be, when perfectly adjusted, greater as the distance increases, and it is on this element that the intensity of the sound depends A. R. MOLISON

Ffynone Club, Swansea, November 15

[Our correspondent is obviously right in supposing that with a beam of light focussed accurately upon the selenium receiver a *single* complete vibration of the transmitting disk would produce *two* periods of maximum and minimum illumination This would not however be the case if the lenses were not set originally to exact focus, for then a displacement of the disk in one direction would scatter the rays more, while a displacement in the other would concentrate them more. In practice, we believe, exact focussing is never obtained or even attempted —ED]

Salts of Zinc

IN Roscoe and Schorlemmer, vol. ii p. 264, it states: "The salts of zinc do *not* impart to the non-luminous flame any tint," and on p. 258, "the metal burns with a bright *white* flame."

What then is the green colour imparted to the Bunsen flame by zinc sulphate due to? Also the green flame obtained by heating metallic zinc on charcoal before the blowpipe? S.

THE green tint referred to by "S." (*supra*) as imparted by zinc sulphate to the Bunsen flame is only observed whilst the water of crystallisation contained in the salt is being given off; the dry salt which remains imparts no colour to the flame It therefore appears probable that the green colouration of the flame is caused by very finely divided particles of the salt being carried off into the upper part of the flame by the escaping water of crystallisation These particles then become so intensely heated as to emit the peculiar greenish light and very likely suffer previous reduction by the carbon of the flame. Other zinc salts, especially the acetate, impart to the flame, when first heated, a greenish-blue tint resembling that observed when metallic zinc is burnt in the air, this being doubtlessly due to a partial reduction of the acetate. The characteristic zinc lines (6362 and 6099 in the red, and 4928, 4924, and 4911 in the blue) are not seen in the case of the salts or when the metal is burnt. A more correct description of the combustion of zinc than that referred to would be "the metal burns with a bluish-white flame."

Chemical Laboratory, Owens College W BOTT

THE WORKS OF CARL VON NÄGELI

THE beginning of the forties in the present century marks an important epoch in the history of botany The "Naturphilosophie" which had for many years so banefully influenced the development of the science, was being routed by the energetic attacks of Schleiden. Botanists were becoming alive to the fact that if their study was to have a place as a science by the side of physics and of chemistry, it must be pursued by the inductive method, that speculation must give way to research, and, above all, that development must be studied before any conclusions could be drawn from the investigation of mature forms. The early discoveries of von Mohl, and the demonstration of the cellular structure of the tissues by Schleiden, were among the first fruits of this awakening. To this period belongs also Nageli's first contribution to science—a paper on the Development of the Pollen (1842) The first sentence in the introduction shows how thoroughly Nageli was imbued with the same spirit which possessed Schleiden He says —"The right knowledge of an object includes an acquaintance with its mature form and a study of its development the one is dependent upon the other, and the one without the other is insufficient to afford a complete conception of the object." The actual observations detailed in the paper appear from the drawings to have been accurate, and they were an important addition to the knowledge of the subject; but their interpretation was so far influenced by Schleiden's theory of cell-formation, which was then prevalent, that the process of the development of the pollen grains is described as being one of free cell-formation.

In the year 1844 appeared the first number of the *Zeitschrift fur wissenschaftliche Botanik*, edited—probably on account of the sympathy existing between them—by Schleiden and Nageli. This short-lived periodical (1844 to 1846) was practically an organ for the publication of Nageli's researches and for the expression of his views, for it does not contain a single contribution from Schleiden's pen The first number opens with an article —a sort of confession of scientific faith—"On the Present Aims of Natural History, and especially of Botany," in which he gives an account of the actual state of botanical knowledge, and strongly urges the necessity of empirical study in order that the generalisations of the science might be in the future, not baseless speculations, but inductions resting upon a firm foundation of ascertained fact The *Zeitschrift* further contains an important paper "On the Nuclei of Cells and the Formation and Growth of Cells," in which the process of free cell-formation, which Schleiden had asserted to be universal, is shown to be only one of the processes by which a multiplication of cells is effected; these processes are clearly defined and classified. This is followed by a number of researches on the morphology of the lower cryptogams, which are of interest inasmuch as they open up new lines of approach to the study of the complicated morphology of more highly

organised plants. Nageli showed, for instance, that since in a unicellular alga (*Caulerpa*) a morphological differentiation of root, stem, and leaf is indicated, morphological is not dependent upon histological differentiation. He discovered also that in the organs of certain cryptogams growth is effected by the repeated segmentation of a single apical cell, and that this segmentation may take place always in one plane only (*Delesseria*), or in two or three planes (stem of *Echinomitrium*, *Phascum*, *Jungermannia*, leaves of mosses).

In the following year (1847) he published his work on "The Classification of the Algæ" ("Die Neueren Algensysteme"), which is of great value, partly on account of the acute criticisms on the various proposed classifications of this group of plants which it contains, but more particularly on account of the number of new facts concerning their structure and life-history which are contributed The descriptions of *Valonia*, *Udotea*, and *Acetabularia* may be especially mentioned it is shown that they have essentially the same structure as *Caulerpa*. The same praise may be awarded to another work, "The Genera of Unicellular Algæ," which appeared two years later.

The next publication of importance was the first number of the *Pflanzenphysiologische Untersuchungen*, and the most interesting of the papers which it contains is the one on the Primordial Utricle Attention is directed to its presence in all living cells, to its influence upon the osmosis of substances in solution into or out of the cell, and to its activity in forming the cell-wall, in short, it is clearly shown to be the living portion of the cell The second number did not appear until 1858, although the MS was ready in 1855, the delay being due principally to Nageli's removal from Freiburg to Zurich, and then again from Zurich to Munich on his acceptance of the Professorship of Botany in that University. Although it must have been vexatious, still the delay enabled Nageli to extend his researches in various directions and thus contributed materially to make the great work on starch-granules one of the most complete monographs which was ever written on any subject. This second number is entirely taken up by this work, which gives an account of these bodies, including their structure, development, chemical composition, and physical properties, as well as their distribution in plants It is a monument of patient, accurate investigation, devoted to a subject which appears, at first sight, to be of limited interest, but which ultimately suggested one of the most remarkable generalisations of modern times, namely, what is known as Nageli's theory of the structure of organised bodies. The primary fact upon which this theory is based is the property which starch-granules have of swelling-up—that is, of absorbing a certain amount of fluid with a consequent increase of bulk—when treated with certain reagents (dilute acids and alkalies), and of diminishing in size in consequence of a loss of water when treated with other reagents (alcohol). From these phenomena he inferred that the starch-granule consists of solid particles, which are impenetrable by water, but which are capable of taking up a certain amount of water between them, and that the amount of this water may vary according to circumstances When the granule is absolutely dry, these solid particles—to which he gave the name of *molecules*—apparently come into perfect contact, for the granule does not lose its transparency, which would be the case if air were included in its substance.

It may be remarked here parenthetically that the word *molecule* used by Nageli to designate these solid particles has not the same sense as it has when it is used in chemistry; one of these molecules is probably an aggregation of chemical molecules. In order to avoid any possible confusion on this score Nägeli has substituted the word *micella* for molecule in his more recent works. The forces by which these micellæ, with their surrounding watery areas, are held together are, firstly, the attraction existing between the micellæ, and secondly, the attraction which exists between each micella and the water which surrounds it; the latter of these attractions must necessarily be greater than the former, but whereas the former varies inversely as the square of the distance, the latter must vary inversely as some higher power Thus, if A represent the attraction between two micellæ, B the attraction between a micella and the water, and D the distance between two micellæ, the limit of swelling-up or imbibition will be reached when $\frac{B}{D^{2+x}} = \frac{A}{D^2}$. As to the form of the micellæ, it is evident that they are not spherical or oval, for in that case the starch-granules would necessarily contain air when dry, and further, the denser parts of them would have to contain at least 26 per cent of water, whereas, as a matter of fact, they only contain 14 per cent They must be therefore more or less polyhedral, but they are not equiaxial since the swelling-up does not take place equally in all directions

By this theory it was found possible to explain satisfactorily certain difficult points of structure, such, for instance, as the stratification of starch-granules and the striation and stratification of cell-walls All these depend upon the alternation, in one or more planes, of dense and less dense layers. The proportion of solid to fluid is greater in the dense than in the less dense layers, or, in the terms of Nageli's theory, the relative size of the micellæ to the watery areas surrounding them is greater in the layers of greater density Further, this theory affords a satisfactory explanation of the mode of growth of a cell-wall It is easy to understand that when the limit of extensibility is nearly reached—that is, when the micellæ of the membrane are separated as far as possible—new micellæ can be deposited in the interstices, the extended condition of the membrane being thus rendered permanent This mode of growth is commonly known as *growth by intussusception*.

This is the stage to which the development of the theory is brought in this work. In the year 1862 Nageli published a paper in the *Proceedings* of the Bavarian Academy on the "Application of Polarised Light to the Study of the Structure of Plants," which advanced it very considerably. He found, in the first place, that organised structures, such as starch-granules or cell-walls, are doubly refractive, and that this property is not affected by causing them to increase or diminish in size in consequence either of the absorption or removal of water, or by mechanical stretching or pressure. From this he concluded that the double refraction is not a property of the organised structure as a whole, but that it belongs to each individual micella hence these micellæ must be crystalline. Again, from the interference colours which these objects present when examined with polarised light, he ascertained that the crystalline micellæ have three axes of elasticity, that they must be bi-axial crystals; and further, by comparing the effect produced by the passage of polarised light through glass under various degrees of pressure, he arrived at the conclusion that the micellæ are so arranged in the membrane of which they form part that one of their axes of elasticity is perpendicular to the surface, whereas the other two axes lie in the plane of the membrane. In a subsequent paper contained in the same periodical, he shows that the crystals of proteid substance, which occur in various seeds and tubers, have the same molecular constitution as starch-granules and cell-walls By close and acute reasoning from carefully observed facts, Nageli has therefore succeeded in establishing this theory of the molecular constitution of organised bodies, a theory which satisfactorily explains many of the peculiarities of structure and properties which they present There can be little doubt that it is justifiable to extend this theory to the explanation of the intimate structure of protoplasm, in fact, in his later publications Nageli has asserted as much, and in

this he is supported by such authorities as Sachs and Strasburger; but it is impossible to say anything at present as to the form and arrangement of the micellæ of protoplasm beyond this, that they do not so act upon polarised light as to suggest that they are crystalline Full details on this subject, as well as a vast amount of other information, is given in the treatise on the Microscope (second edition, 1877), which Nageli wrote together with Schwendener; fortunately an English edition of this important work may soon be expected to appear.

In tracing the development of Nageli's theory, it has been necessary to depart from the chronological order of his works In the years between 1858 and 1868 he published his *Beiträge zur wissenschaftlichen Botanik*, which include several important works, for the most part anatomical. In the first number there is an elaborate paper on "The Arrangement of the Fibro-vascular Bundles and the Mode of Growth in the Stem and Root of Vascular Plants," which is important as containing a purely morphological classification of the different forms of tissue of which these organs consist. This is followed by a detailed account, in the fourth number, of the mode of growth in thickness and of the arrangement of the fibro-vascular bundles in the stem among the Sapindaceæ, and this number also contains Nageli's well-known investigation into the mode of development and growth of roots, in which Leitgeb was associated with him This publication has a further interest connected with it, in that Schwendener's first papers on what is now known as his Lichen-theory appeared in it.

During this period Nageli frequently contributed papers (the *Botanische Mittheilungen*) on a variety of subjects of botanical interest to the *Proceedings* of the Bavarian Academy, an activity which continues up to the present time. Allusion has already been made to some of these, and it would be worth while, did space permit, to give an account of most of them Among the more important the following may be mentioned —"On the Sieve-Tubes of Cucurbita," "On the Proteid Crystalloids of the Brazil-nut," "On the Development of Varieties," "A Theory of Hybridisation." Of late years Nageli has turned his attention more especially to the study of the chemical composition and vital processes of the lower Fungi, such as Yeast and Bacteria Among the interesting results obtained is the discovery, in yeast-cells, of a ferment (invertin) which converts cane- into grape-sugar, and of peptones But the real importance of these researches only became apparent on the publication of two larger works, viz. "The Lower Fungi in their Relation to Infectious Disease" (1877), and "A Theory of Fermentation" (1879) It is of course impossible to give here anything like a satisfactory account of the contents of these two books. The first treats fully of the important part played by Bacteria in infection and contagion, showing, in fact, that these organisms are the causes and carriers of the various forms of disease. In the second, after an exhaustive account of the process of alcoholic fermentation has been given, a new theory of it is propounded, based, not upon chemical principles, like that of Liebig, but upon the principles of molecular physics. Fermentation is defined as being "the communication of the oscillations of the molecules, groups of atoms, and atoms of the substances composing the living protoplasm to the molecules of the fermentible substance, in consequence of which the equilibrium of the molecules of that substance is disturbed, and decomposition is the result." It is also pointed out that, in the case of yeast, the sugar is to some extent decomposed within the cells, but for the most part outside them.

Though this account of his works is but little more than an enumeration of them, yet it will suffice to show how important are Nageli's contributions to botanical science in the departments of morphology, anatomy, and physiology, not merely as additions to the accumulated store of facts, but as new generalisations from those facts, and as opening up fields for future research.

SYDNEY H. VINES

PROF. TAIT ON THE FORMULA OF EVOLUTION[1]

ANOTHER point to which I ought thus early to direct your attention is the necessity for perfect definiteness of language in all truly scientific work. Want of definiteness may arise from habitual laziness, but it much more commonly indicates a desire to appear to know where knowledge is not. Avoid absolutely all so-called scientific writings in which (as Clerk-Maxwell said) the attempt is made to "give largeness of meaning" to a word by using it sometimes in one sense and sometimes in another. It is true that we may thus economise in our language, and avoid the necessity for introducing new and hard terms But it would be a most expensive and pernicious economy. It is only a blockhead who could object to the use of a new term for a new idea.

Our only source of information in physical science is the evidence of our senses. To interpret truly this evidence, which is always imperfect and often wholly misleading, is one of the tasks set before Reason It is only by the aid of reason that we can distinguish between what is physically objective, and what is merely subjective Outside us there is no such thing as noise or brightness:—these no more exist in the aerial and ethereal motions, which are their objective cause, than does pain in the projectile which experience has taught us to avoid You will find many prominent ideas, relics of a less enlightened age, from which Natural Philosophy has not yet wholly shaken itself free, which owed their existence solely to the confusion of the subjective with the objective

With observation and experiment as our sole sources of information we have no right, in physical science, to introduce *à priori* reasoning We may (unprofitably of course) speculate on what things might have been, but we must not dogmatise on what they ought to have been, we must simply try to discover what they are.

For aught that we can tell, the properties of matter, and physical laws in general, might have been other than we find them to be How can any one of us tell whether his conscious self might not have been associated in life with the body of an Eskimo or of a New Zealander, instead of with what he (no doubt) considers its much preferable tenement? Speculations of such a kind must always be wholly unproductive and unprofitable, but for all that we cannot but allow that they are not intrinsically absurd

Some years ago a critic of Mr. Herbert Spencer's Philosophy happened to quote from a book of mine the remark I have just made (that the properties of matter might have been other than we find them to be). Mr. Spencer's observation on this point is highly instructive Had he not been a severely grave philosopher I should have taken it for a joke. He said, "Does this express an experimentally ascertained truth? If so, I invite Prof. Tait to describe the experiments."[2] Mr Spencer has quite recently published a species of analytical inquiry[3] into my "mental peculiarities," "idiosyncrasies of thought," "habits of mind," "mental traits," and what not. From his illustrative quotations it appears that some or all of these are manifested wherever there are differences between myself and my critic in the points of view from which we regard the elements of science. Hence they are not properly personal questions at all, but

[1] Part of an Introductory Lecture delivered October 26, 1880

[2] In my letter (NATURE, vol ix p 402) will be found an illustrative anecdote, which Mr. Spencer declares to be "*not to the point*" A great scientific man, to whom I showed the correspondence, remarked that Mr Spencer must be the only man in England who could not see the perfect appositeness of the anecdote.

[3] *Appendix to First Principles, dealing with Criticisms.* (Williams and Norgate, 1880)

questions specially fitted for discussion here and now. I may, therefore, commence by inquiring what species of "mental peculiarity" my critic himself exhibited when he seriously asked me whether I had proved *by experiment* that a thing might have been what it is not!!

The title of Mr. Spencer's pamphlet informs us that it deals with *Criticisms*; and I am the first of the subjects brought up in it for vivisection, albeit I have been guilty (on Mr. Spencer's own showing) only of "*tacitly*" expressing an opinion! Surely my vivisector exhibits here also some kind of "mental peculiarity." Does a man become a critic because he quotes, with commendation if you like, a clever piece of analysis or exposition published by another?

In NATURE for July 17, 1879, I reviewed Sir E. Beckett's able little book, "Origin of the Laws of Nature," and as an illustration of that author's method I said:—

"He follows out in fact, in his own way, the hint given by a great mathematician (Kirkman) who made the following exquisite translation of a well-known definition:—

"'Evolution is a change from an indefinite, incoherent, homogeneity to a definite, coherent, heterogeneity, through continuous differentiations and integrations.'

"[Translation into plain English]—'Evolution is a change from a nohowish, untalkaboutable, all-alikeness, to a somehowish and in-general-talkaboutable not-all-alikeness, by continuous somethingelsifications and sticktogetherations.'"

Later in my article occurs the following paragraph, which also is quoted by Mr. Spencer:—

"When the purposely vague statements of the materialists and agnostics are thus stripped of the tinsel of high-flown and unintelligible language, the eyes of the thoughtless who have accepted them on authority (!) are at last opened, and they are ready to exclaim with Titania

"Methinks 'I was enamour'd of an ass.'"

The translation is from Kirkman's remarkable work, "Philosophy without Assumptions," which at that date I had just read with pleasure and profit. Humiliating as the confession may appear, I there saw Mr. Spencer's "Formula" for the first time, and I did not notice the title given to it. Hence, in quoting it from Kirkman, I very naturally called it by its proper name, a "Definition." For this I have incurred the sore displeasure and grave censure of the inventor of the definition. It seems I should have called him the *discoverer of the formula*! Now this is no petty quibble on words. It involves, as you will see immediately, an excessively important scientific distinction, to which your attention cannot be too early directed.

Mr. Spencer complains that an American critic (whose estimate is "tacitly" agreed in by Mr. Matthew Arnold) says of the "Formula of Evolution":—"This may be all true, but it seems at best rather the blank form for a universe than anything corresponding to the actual world about us." On which I remark, with Mr. Kirkman, "Most just, and most merciful!" But mark what Mr. Spencer says:—

"On which the comment may be that one who had studied celestial mechanics as much as the reviewer has studied the general course of transformations, might similarly have remarked that the formula—'bodies attract one another directly as their masses and inversely as the squares of their distances,' was at best but a blank form for solar systems and sidereal clusters."

We now see why Mr. Spencer calls his form of words a *Formula*, and why he is indignant at its being called a *Definition*. He puts his Formula of Evolution along-side of the Law of Gravitation! Yet I think you will very easily see that it is a definition, and nothing more. By the help of the Law of Gravitation (not very accurately quoted by Mr. Spencer) astronomers are enabled to predict the positions of known celestial bodies four years beforehand, in the *Nautical Almanac*, with an amount of exactness practically depending merely upon the accuracy of the observations which are constantly being made:—and, with the same limitation, the prediction could be made for 1900 A.D., or 2000 A.D., if necessary. If now Mr. Spencer's form of words be a formula, in the sense in which he uses the term as applied to the Law of Gravitation, it ought to enable us to predict, say four years before-hand, the history of Europe, with at least its main political and social changes! For Mr. Spencer says that his "formula" expresses "all orders of changes in their general course,—astronomic, geologic, biologic, psychologic, sociologic", and therefore "could not possibly be framed in any other than words of the highest abstractness."

Added, November 11, 1880

Mr. Kirkman has lately "discovered a formula" more general than that of Evolution, the "Formula of Universal Change." Here it is:—

"Change is a perichoretical synechy of pamparallagmatic and porroteroporeumatical differentiations and integrations."

Even to this all-embracing formula, with Mr. Spencer's leave, I would apply the humbler but fitter term "definition."

Of Mr. Spencer's farther remarks there are but three which are directed specially against myself (Mr. Kirkman is quite able to fight his own battles). He finds evidence of "idiosyncrasies" and what not, in the fact that, after proclaiming that nothing could be known about the physical world except by observation and experiment, I yet took part in writing the "Unseen Universe"; in which arguments as to the Unseen are based upon supposed analogies with the seen. He says:—"clearly, the relation between the seen and the unseen universes cannot be the subject of any observation or experiment, since, by the definition of it, one term of the relation is absent." I do not know exactly what "mental peculiarity" Mr. Spencer exhibits in this statement. But it is a curious one. Am not I, the thinker, a part of the Unseen, no object of sense to myself or to others, and is not that term of relationship between the seen and the Unseen always present? But besides this, Mr. Spencer mistakes the object of the book in question. The theory there developed was not put forward as probable, its purpose was attained when it was shown to be conceivable and not inconsistent with any part of our present knowledge.

Mr. Spencer's second fault-finding is *àpropos* of a Review of *Thomson and Tait's Nat. Phil.* (NATURE, July 3, 1879) by Clerk-Maxwell, knowing of course perfectly well that the authors were literally quoting Newton, and that they had expressly said so, jocularly remarked "Is it a fact that 'matter' has any power, either innate or acquired, of resisting external influences?" Mr. Spencer says:—"And to Prof. Clerk-Maxwell's question thus put, the answer of one not having a like mental peculiarity with Prof. Tait, must surely be—No." Mr. Spencer, not being aware that the passage is Newton's, and not recognising Maxwell's joke, thinks that Maxwell is at variance with the authors of the book!

Finally, Mr. Spencer attacks me for inconsistency &c. in my lecture on Force (NATURE, September 21, 1876). I do not know how often I may have to answer the perfectly groundless charge of having, in that Lecture, given two incompatible definitions of the same term. At any rate, as the subject is much more important than my estimates of Mr. Spencer's accuracy or than his estimates of my "mental peculiarities," I may try to give him clear ideas about it, and to show him that there is no inconsistency on the side of the mathematicians, however the idea of force may have been muddled by the metaphysicians. For that purpose I shall avoid all reference to "differentiations" and "integrations"; either as they

are known to the mathematicians, or as they occur in Mr. Spencer's "Formula." Of course a single line would suffice, if the differential calculus were employed.

Take the very simplest case, a stone of mass M, and weight W, let fall. After it has fallen through a height h, and has thus acquired a velocity v, the Conservation of Energy gives the relation

$$M\frac{v^2}{2} = Wh$$

Here both sides express *real things*, $M\frac{v^2}{2}$ is the kinetic energy acquired, Wh the work expended in producing it.

But if we choose to divide both sides of the equation by $\frac{v}{2}$ (the average velocity during the fall) we have (by a perfectly legitimate operation)

$$Mv = Wt,$$

where t is the time of falling. This is read—*the momentum acquired is the product of the force into the time during which it has acted* Here, although the equation is strictly correct, it is an equation between purely artificial or non-physical quantities, each as unreal as is the product of a quart into an acre. It is often mathematically convenient, but that is all The introduction of these artificial quantities is, at least largely, due to the strong (but wholly misleading) testimony of the "muscular" sense.

Each of these modes of expressing the same truth, of course gives its own mode of measuring (and therefore of defining) force

The second form of the equation gives

$$W = \frac{Mv}{t}$$

Here, therefore, force appears as the time-rate at which momentum changes, or, if we please, as the time-rate at which momentum is produced by the force In using this latter phrase we adopt the convenient, and perfectly unmisleading, anthropomorphism of the mathematicians This is the gist of a part of Newton's second Law.

The first form of the equation gives

$$W = \frac{M\frac{v^2}{2}}{h},$$

so that the same force now appears as the space-rate at which kinetic energy changes, or, if we please, as the space-rate at which energy is produced by the force

Here are some of Mr Spencer's comments—"force is that which changes the state of a body, force is a rate, and a rate is a relation (as between time and distance, interest and capital); therefore a relation changes the state of a body."

The contradiction which Mr. Spencer detects here, and over which he waxes eloquent and defiant, exists in his own mind only. The anthropomorphism which has misled him is but a convenient and harmless relic of the old erroneous interpretations of the impressions of sense.

P. G. TAIT

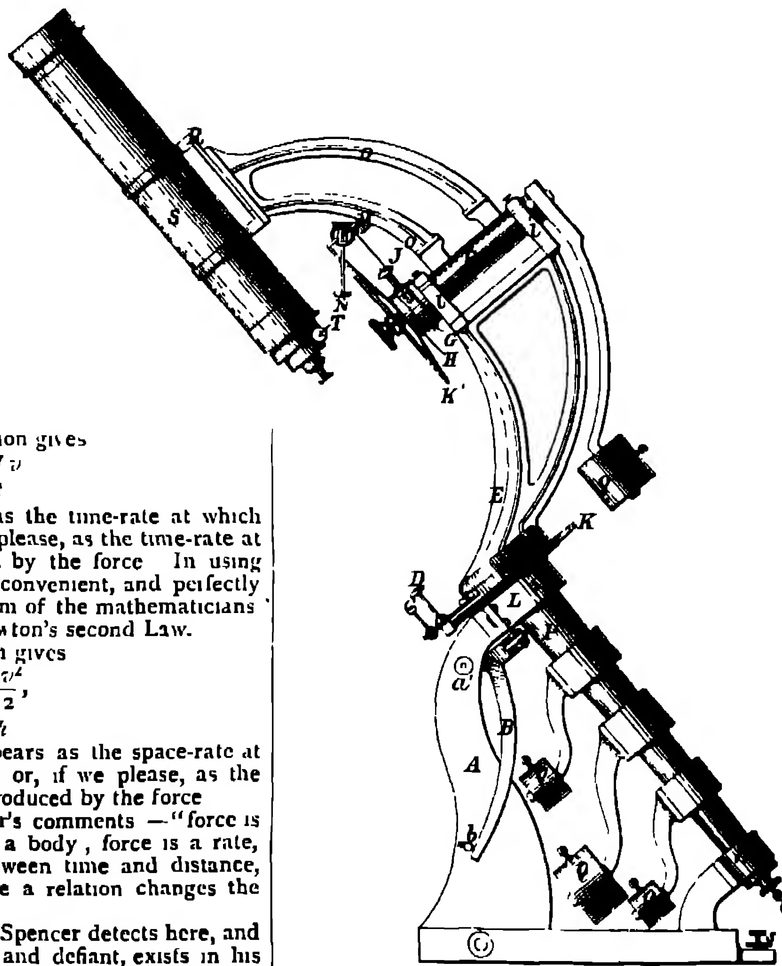
COMET-FINDERS

IT is only lately that the meteorites, or many of them which we see of a night making bright streaks in the heavens, have been shown to belong to definite streams having definite orbits and periods, and with the increase of our knowledge of these orbits the number of comets identified as travelling in the same orbits as meteor-streams has likewise advanced.

Now that the intimate relation between comets and meteorites has been settled, greater interest attaches to the discovery of these casual visitors, many of which have passed in our neighbourhood unobserved This is shown by the increased number of comets seen, now that it is part of the business of several observatories to keep up a systematic search

To do this properly, a telescope of large field of view is required, and a constant sweeping of the heavens must be kept up, and to do this with an ordinary equatorial is extremely tedious, owing to the continual change of the position of the body required.

To go back to early days of comet-finding, we call to mind the first instrument specially constructed for the purpose, so far as we are aware It is a telescope of Galilean construction, with an object-glass of 2½ inches



diameter, and having a total length of 5 inches. This was made by Dollond during the first few years of this century for Dr. Kitchener Since that time astronomical instruments have grown apace, and we have now before us Dr. Carl's "Repertorium fur Experimental-Physik" containing a description of the new comet-finder constructed by Herr Schneider for the Observatory at Vienna.

The telescope of this instrument has an object-glass of

6 inches aperture and 4½ feet focal length, and the mounting is a striking change from what we are usually accustomed to see. The great point to be attained by it is to carry the telescope equatorially and allow it to move on a declination axis in such a manner that the eye-end remains stationary while sweeping the heavens It will be seen from the plate which, by the kindness of Dr. Carl, we are able to reproduce, that the declination axis is carried above the polar axis somewhat in the usual way, but that the telescope, instead of being carried by its middle at the end of the declination axis, is carried by a frame, O, so that the eyepiece is in the prolongation of that axis, and also in the prolongation of the polar axis, so that it remains stationary, while the object-glass sweeps in all directions. The handles D and N, within easy reach of the observer, enable him to give the requisite motion to the telescope without the change of position necessary with an ordinary instrument The telescope is balanced on the declination axis F by the counter-weight Q, and the excess of weight on one side of the polar axis is balanced by the counter-weights Q Q Q

Herr Schneider proposes to mount telescopes of much greater size, say 30 or 40 feet long, in the same manner.

NOTES

M. MILNE-EDWARDS having completed the publication of his great work on "Physiologie Comparée," a subscription has been opened by M Dumas, the Perpetual Secretary of the Academy of Sciences, for the purpose of presenting the veteran zoologist with a gold medal. Subscriptions are to be sent to M Maindron at the Secretariat of the Academy of Sciences, or to M. Victor Masson, publisher, Boulevard St Germain, Paris M. Milne-Edwards's great work is composed of fourteen large octavo volumes—the first four of which are out of print—of 500 pages each; the publication began in 1857, and has been accomplished by twenty-three years of continual work It includes all the lectures which have been delivered by M Milne Edwards at the Museum of Natural History during that lengthened period, and could not have been accomplished if the author had not had the advantage of the immense scientific resources accumulated in that establishment during the last two centuries for the study of nature.

A VIENNA correspondent sends us the following data regarding the Agram earthquake:—The damp ejected matter of the mud-volcano at Resnica near Agram was found to contain no elementary sulphur nor sulphuretted hydrogen, but it contained sulphur metals decomposable by acids, and earthy carbonates, along with organic substances of a humus nature The chief constituent of it is fine sand with water, and it comes from no great depth. The mud volcano at Sevete, near Agram, also ejects (2 m. high) chiefly a clayey-sandy mud, which may be thrown up by movements of the ground water The Gratz geologist, Peters (writing in the *Tagespost*), characterises the Agram earthquake of November 9 to 14 as one of the most normal which could be observed in that region. The movement kept exactly the direction of south-south-west, and was thus precisely at right angles to the chief direction of the Eastern Alps The entire breadth of the territory affected appears to be indicated by the towns of Klagenfurt (Carinthia) and Szegedin (Hungary). Since the formation of the Alps, and so through a long series of geological periods, all subterranean movements in this region of Central Europe have been in this one direction (as Suss first showed). For some months past movements have been perceived to be in progress in various localities. That Agram should be affected as it has been is explained by an inspection of the geological map Not very far north from that town rises a remarkable block of greenstone surrounded by chlorite schist, limestone and other layers. A not very broad band of recent Tertiary deposits separates the low ground from that mountain block, which thus forms a comparatively fixed point in the system. Every movement coming from south south-west propagated by these strata must impinge horizontally on the green stone block, and cause a greater or less curvature of the strata, which manifests itself most where the lower ground remains free from Tertiary deposits. Unfortunately for Agram the strongest movement was directed precisely against that mountain block, and so upon the town before it The whole phenomenon has nothing to do with volcanic processes. The repetition of the shocks is easily explained by the reaction from curvature of the strata not occurring all at once. In opposition to Peters, the astronomer and meteorologist, Rudolph Falb of Gratz, holds the Agram earthquake to be volcanic, and connected with the strong attraction of subterranean lava by the moon They seem to have continued at more or less frequent intervals during the past week.

IN several parts of the Tyrol (Hall, Thaur, Rum, Innsbruck) an earthquake-shock was experienced on the 14th inst. about 9 15 a m, and on the same day there was a considerable shock (lasting 20 sec.) in Bavaria, at Partenkirchen and Mittenwald about 8 p.m. Dr. Franz Woehner has been delegated by the Vienna Academy to Croatia to report on the phenomena.

A CYCLONE accompanied by earthquake shocks is reported to have occurred at Sitka in Alaska on October 25, causing much devastation.

JUST after the death of its founder, Dr Broca, the well known *Revue d'Anthropologie* entered on its tenth year His successor in the direction of the *Revue*, Dr. Topinard, issues a prospectus intimating that it will be continued with renewed energy on the lines laid down by its founder. The *Revue* embraces all the varied departments of anthropology, and its editor has the collaboration of the most eminent workers in the varied departments in France Broca left a great number of anthropological papers in various stages of completeness, and these are to be published in successive numbers of the *Revue*, which deserves every encouragement.

THE laboratory of M Lacazes Duthiers at the Sorbonne has been opened this year again for experiments in zoology In the summer it will be transferred to the coast station in Brittany

THE Paris Museum of Natural History being situated in a somewhat out-of-way place, is rather deserted by the students, and great efforts are made to render the course of lectures which are delivered there unusually attractive. M. Fremy, Lecturer on Chemistry, will speak on the great discoveries in chemistry made almost simultaneously in Paris and in London about a century ago, and will perform all the original experiments, some of them with the very instruments which were used by the discoverers.

A VERY interesting acquisition has just been made by the botanical department of the British Museum In 1783–4 John Millar made a series of water colour drawings for the Earl of Bute, showing the "leaves, stalks, and ramifications of plants, for the purpose of ascertaining their several species" They are bound in five volumes, with an elaborately flourished title page, and fill 928 octavo pages. The museum has purchased the drawings.

THE seismograph on Mount Vesuvius is said to indicate great subterranean dynamism Streams of lava continue to flow down the north-west side of the cone, and are increasing both in volume and number. "The Vesuvian eruption," the *Times* correspondent states, "has entered on a phase of greatly increased activity. The news reached us on Saturday, but, as it appeared only in those papers which are directly interested in the Funicular

Railway, it was looked upon as an exaggeration to attract Sunday excursionists. It is now, however, confirmed that the lava is flowing over the side towards Naples, and, after having destroyed the outwork built to protect the upper station of the railway, is running rapidly in a vivid streak of fire parallel to the line, but at a distance which does not thus far imperil its safety. The spectacle is described as magnificent, and crowds were out watching the course of the lava and speculating on the fate of the Funicular Railway."

AN International Congress of Electricians accompanied by an International Exposition of Electricity will be held in Paris during the autumn of 1881. This Exposition is to be opened (under the patronage of the Government, though at the pecuniary risk of private parties) on August 1, and to continue until November 15 following. The Congress of Electricians will meet on November 15 in the rooms of the Palace of the Trocadéro. Opportunity will be given for exhaustive research in all the various branches. The Exposition will remain open each evening until eleven o'clock to afford opportunities of testing the practicability of the different systems of electric lighting. The Congress is to assemble under the presidency of the Minister of Posts and Telegraphs, and the vice presidency of three French and three foreign delegates.

ON February 10, 1879, a few gentlemen interested in the study of man met in the Smithsonian Institution to devise a method of mutual improvement The effort resulted in the formation of the Anthropological Society of Washington, with Major Powell for president, and Dr. Reynolds and Prof O T Mason as recording and corresponding secretaries. Twenty-four papers have been read, which, if one might judge from their titles, are most interesting and valuable contributions We learn from the *American Naturalist* that it is not yet decided whether a journal will be published, inasmuch as the Smithsonian Institution and the Bureau of Ethnology "afford ample opportunities of preserving all papers of permanent value." Without doubting this fact, we still hope that this young and vigorous society may not only have its own publication, but also that a long career of activity may ensue to provide the material for filling the pages of the same.

HERR V. BERGSO, in a recent work, "Fra Mark og Skov,' has given some interesting data in regard to the habits of the Tarentula, *Lycosa tarentula*, Latr, whose nests he has traced and examined on the Roman Campagna. He found that the nest, which was well rounded and smooth, was approached by a tunnel which, after running about a foot straight down below the surface of the ground, made a sudden short turn before it finally descended for about another foot into the spider's abode The entrance to the tunnel is concealed by an arched covering made by the interlacing of grasses and leaves. The eggs are inclosed in a spun bag, and the young appear in the autumn, when they immediately seat themselves on the body of the mother where they remain till about April, neither parent nor offspring seeking food during their hybernation. As many as 291 individuals were on one occasion removed in February from the body of an emaciated tarentula. The superstitious error of assuming that the bite of the animal induces an irresistible desire of dancing is due to the fact, that dancing having been originally employed as a remedy against the poison, which is believed to be eliminated by profuse perspiration, the action of the poison was confounded with the means of its eradication.

EXOTIC butterflies have long, from their beauty, engaged the enthusiastic attention of wealthy collectors, some of whom, as notably the late Mr. Hewiston, have also enriched entomological literature with works containing coloured figures of their favourite insects. M. C. Oberthür of Rennes, who, with his brother René, is the possessor of a very extensive entomological museum, in which is contained the late Dr. Boisduval's collection of Lepidoptera, has just published his Quatrième livraison of a work, "Études d'Entomologie," which has more or less regularly appeared during the last few years. The present part is devoted to the "Papilionidæ" of his collection, and six coloured plates illustrate the species and varieties which he considers it necessary to describe.

MUCH interest has been excited in Norway by the recent appearance of a colony of beavers on the Voldifjord, a branch of the Frierfjord, which is at a considerable distance from the beaver-station still remaining at Omli on Nedenæs.

UNDER the title *Iagttagelser over Nordlys anstillede i Norge, Sverige og Danmark*, bearbeidede af Sophus Tromholt (Christiania), we have the results yielded by 839 observations of the aurora borealis, at 132 Scandinavian stations, on 154 nights, between September 1878 and April 1879 on which the northern light was visible. These observations are arranged under four heads in accordance with (1) longitude and latitude of stations; (2) time of year and age of moon; (3) colour, form, and altitude of streamers; (4) sound. Herr Tromholt considers that it may be accepted as certain, that the aurora is a local phenomenon, circumscribed by narrow limits, and manifested at inconsiderable distances from the earth's surface; that the light is generally white, and less often red or green, but that in latitudes higher than Bergen it not unfrequently presents spectral colours; and that the accompaniment of sound is an indisputable fact in relation to the auroral phenomenon. We learn from *Naturen* that Herr Tromholt has resumed his observations of the aurora borealis, to which he has devoted his attention for many years. It is his intention to make a catalogue of every recorded manifestation of the northern light in Norway, and for this purpose he requests the co-operation of other observers, and will be grateful for reference to any foreign sources of information, such as ships' logs, journals, weather tables, almanacs, &c., which might yield materials towards the better elucidation of this phenomenon.

IN a letter addressed to Mr. Cust by Prof. F. W. Newman, and just published in the *Journal* of the Royal Asiatic Society, on the Libyan languages, the writer remarks that St Augustine in his own day attested that one language prevailed in Roman Africa, and that it was quite natural to suppose the same to be the case now, when a large and striking similarity was found in the leading nouns and verbs. The changes however induced in 1500 years have broken up the original unity, and Prof Newman states that we are now forced to admit at least four languages, each differing from the other more than German from Dutch, or Portuguese from Spanish.

THE annual course of five lectures in connection with the Brown Institution will be delivered by Dr. W. S. Greenfield, Professor-Superintendent, in the theatre of the University of London, Burlington Gardens, W., on December 13, 15, 17, 20, and 22, at 5 30 p m. Subject Further Investigations on Anthrax and Allied Diseases in Man and Animals. Microscopic specimens will be exhibited on December 22 from 4.30 p.m.

WE learn from *Psyche* that Miss Emily A. Smith, a well-known entomologist of Peoria, Illinois, has gone to Leipzig, where, if the university authorities will allow it, she will pursue a general course of zoological work in the new laboratory of Prof. Leuckart This lady was recently elected a member of the Entomological Society of London.

CAPT. H. KING, R.N., writes with reference to the instances of fascination mentioned at p. 56, vol. xxiii., that having heard that the American ostrich might be enticed within gunshot by a person lying upon his back and kicking his legs and arms in the

air, he tried this with perfect success in Uruguay; he supposes that curiosity was the motive. A large coral upon the copper of a man-of-war, Capt. King states, is not unprecedented, he remembers in 1839 seeing one of the size and shape of a large cauliflower, taken from the bottom of a vessel of the Indian navy, in the Persian Gulf, by a pearl-diver.

PROF. GRAHAM BELL has promised to read a paper before the Society of Arts upon his "Photophone" at the ordinary meeting on Wednesday, December 1. As considerable interest is likely to attach to this paper it is announced that only members of the Society can be admitted, and that they will be required to provide themselves with special tickets issued for the occasion.

WE referred in the "Physical Notes" of our issue of November 11 to a paper read before the American Association at Boston by Prof. Young, which combated certain phenomena in thermo electricity which were alleged to have been observed by Herr Exner. We have since received from Mr T. Brown of Belfast a letter in which, on behalf of Prof Franz Exner of Vienna, he expressly disavows any such discoveries as those which Prof Young has set himself to refute. We readily accord to our courteous correspondent the opportunity for this disavowal, since any reflections cast even inadvertently upon the accuracy of Prof. Franz Exner's work might unfairly prejudice readers against the general reliability of the researches which he has published in another department of science, and which our readers are aware are just now exciting considerable attention

IN NATURE, vol. xxii. p. 616, it was stated, on the authority of the Japanese papers, that Prof. Atkinson had, "during a sojourn in the Mitake Mountains of the Province of Koshu, discovered another valuable deposit of coal." We are now informed that although Mr. Atkinson visited the Mitake Mountains last summer, he can lay no claim to so important a discovery.

THE Hon Sir Ashley Eden, K C S.I., has appointed Babu Ambika Churn Sen, M.A., and Synd Sakhawat Hossein, B.A, a native of Behar, to the two scholarships of 200*l*. a year each, recently created by the Bengal Government to be held at the Royal Agricultural College, Cirencester.

THE Procureur-General of Paris having sent an explanatory note stating that he did not mean to attack the character of the medical advisers of the public prosecutor, but merely to give vent to his peculiar views, these gentlemen have withdrawn their resignations and resumed their work.

THE Cutlers' Company have arranged for a course of lectures being delivered, or papers read, at the hall of the company during the ensuing winter season. The course will consist of four lectures or papers upon subjects intimately connected with the materials used in the manufacture of cutlery, the lectures to take place on the following dates:—Wednesday, December 1, 1880, Wednesday, January 5, 1881; Wednesday, February 2, 1881; Wednesday, March 2, 1881. Sir Henry Bessemer, C.E, F.R.S., has promised to commence the course, and will, on December 1, read a paper "On the Manufacture and Uses of Steel, with special reference to its employment for Edge Tools." The admission will be entirely free, but by ticket, which may be obtained on application to the hon. secretary, addressed to the Cutlers' Hall.

IT is announced that the electric cable manufacturing firm, Berthoud Borel and Co. of Cortaillod, in Neuchâtel, have made a highly important discovery in practical telegraphy. After a long and expensive series of experiments they have succeeded in devising a method of laying cables whereby the inductions of the electric current from one wire to another, although the wires are in juxtaposition, is prevented. This discovery, it is asserted, removes the last obstacle in the way of the widest possible extension of facilities for telephonic communication.

OUR ASTRONOMICAL COLUMN

THE THIRD COMET OF 1869.—This comet, the orbit of which has so close a resemblance to that of the comet discovered by Mr. Swift on October 11, was detected at Marseilles by M. Tempel on November 27, 1869, in the constellation Pegasus, and appears to have been last observed on December 31 at Leipsic and Kremsmunster, the hope of seeing it after the next period of moonlight not having been verified. On November 29 Dr. Vogel, observing at Leipsic, described it as a very faint large object elongated in the direction of the declination circle: in the comet-seeker its diameter was about 6′. On December 7 it was still very faint, large, and elongated in the direction 300°, the central condensation very slight. On the following night its diameter was 5′, it had "a peculiar milky appearance" and hardly any central condensation, so that observations were attended with difficulty. On the 21st it was seen only with much exertion of the eye, but on the 31st, though the comet was very faint, Prof. Bruhns considered his separate comparisons certain to about ten seconds of arc. At Kremsmunster Prof. Strasser found it "extraordinarily faint" during its entire visibility, and in consequence of wanting central condensation, very difficult to observe, and hence considered that his positions would not possess the ordinary degree of accuracy. The elements of the orbit were calculated by Tiele, Oppolzer, Schulhof, and Bruhns, the parabolic orbit published by the latter in No 1788 of the *Astronomische Nachrichten* being founded upon nearly the whole extent of observation, he remarks with respect to it:—"Eine angestellte Vergleichung hiesigen Beobachtungen scheint aber doch auf eine Abweichung der Bahn von der Parabel hinzudeuten . . " We are not aware that any further examination of this point was made. If the period of revolution be really something less than eleven years, the circumstance of the comet having escaped observation prior to 1869 will not nevertheless occasion surprise, considering that both in 1869 and 1880 it has approached near the earth and has yet been very faint and diffused, so that when the perihelion passage has occurred at other seasons of the year it might be beyond reach of the telescope. It will be most essential for the theory of the comet's motion that observations should be continued as long as possible at the present appearance, that if it prove to be one of short period its next return to perihelion may be closely predicted · the computation of the planetary perturbations during the period 1869-80 will of course be a necessary process with this object in view.

THE STAR LALANDE 1013-4.—Mr. G. Knott has examined this star, to which we lately drew attention, as being credited with the very discordant magnitudes 5, 7·7, and 10. He writes from Cuckfield on November 21: "I looked the star up on November 8 and again on November 19, and found it on each occasion 7 9 mag, and sensibly equal to B.D. + 51°, No 131, which forms a convenient comparison star This estimate, it will be seen, agrees nearly with that in the *Durchmusterung*; Harding marks the star 6m.

CHEMICAL NOTES

IN the last number of the *Berichte* of the German Chemical Society Herr v. Lippmann describes experiments which show that a solution of pure cane sugar, when charged with carbon dioxide, is slowly converted into inverted sugar. If the carbon dioxide be pumped into the sugar solution under pressure, the rate of inversion is considerably increased: at 100° the inversion takes place rapidly.

IN the *Annales Chim. et Phys.* the results of M. Raoul's experiments on the freezing points of alcoholic liquids are detailed. An aqueous solution of alcohol containing 1·6 per cent. by volume freezes at − 0·5; a solution containing 47 9 per cent. freezes at − 32°. The freezing point of solutions containing from 24 to 51 gram alcohol per 100 grm. water is decreased by 0°·528 for each gram of alcohol: when more than 51 grm. alcohol are present to 100 grm. water no regular decrease in the freezing point was observable. The freezing points of various wines are given in the paper referred to.

IN *Comptes rend.* M Kessler announces that he has prepared a crystallised hydrate of hydrofluosilicic acid, viz., $H_2SiF_6 . 2H_2O$. The hydrate is a hard, colourless, very deliquescent solid, which fumes strongly in air, and melts at about 19°.

IN the same journal M. de la Source describes his experiments on the dialysis of ferric oxide dissolved in a solution of ferric chloride. "Fer Bravais" of medicine consists of $30Fe_2O_3 . Fe_2Cl_6$; after three months' dialysis of a dilute solution of this substance the greater part of the chlorine had passed into the dyalysate, the proportion of ferric oxide to chloride was then $116Fe_2O_3 . Fe_2Cl_6$, and the chlorine yet continued to pass through the dialyser. The author thinks that ferric hydrate is, *per se*, under certain conditions soluble in water.

HERR A. HERZEN describes in *Biol. Centralblatt* some experiments on acetous fermentation. In each of three flasks was placed 100 c.c pure water, to the first flask 10 per cent. pure alcohol and a drop from the surface of a fermenting wine full of *Mycoderma aceti* were added, to the second flask were added 5 per cent. of pure acetic acid and a drop of the fermenting wine, and to the third flask were added 5 per cent. acetic acid, 5 per cent. of a saturated solution of boric acid, and a drop of the fermenting wine. After eight days at 25° no *Mycoderma* appeared in the first flask, much appeared in the second, and a little in the third. Hence the author concludes that *Mycoderma aceti* lives at the expense of acetic acid already formed in wine, and that it does not cause the transformation of alcohol into acetic acid, but that it is rather a consequence of this chemical change; further, that boric acid retards the development of *Mycoderma*, but does not prevent it in presence of already-formed acetic acid.

IN *Dingler's Polytech-Journal* a paper appears by Drs Lunge and Schappi, on bleaching-powder The results confirm the now generally accepted formula first proposed by Odling, viz., CaOClCl.

IT was shown some time ago by H. T Brown that alcoholic fermentation proceeds more slowly under diminished than under ordinary pressure According to Boussingault (*Compt. rend.*), however, sugar is rapidly transformed into alcohol by the action of yeast, if the carbon dioxide and alcohol, as these are produced, be rapidly removed from the fermenting liquid. Addition of alcohol soon stops fermentation under ordinary circumstances, Boussingault shows that if the vessel containing the fermenting liquid be connected with an air-pump which is worked energetically, fermentation proceeds rapidly even when a considerable amount of alcohol has been added to the liquid.

IN connection with the recent liquefaction of ozone by Hautefeuille and Chappuis, the following numbers, from a paper by the same authors in *Compt rend.*, are of interest, as showing the exact influence of temperature and pressure on the ozonising of oxygen Diminution of pressure does not tend to increase the amount of ozone produced, but decreased temperature exerts a marked action in increasing the amount of oxygen transformed into ozone —

Tension of oxygen.	Tension of ozone				Proportion of ozone by weight			
	−23°	0°	20°	100°	−23	0°	20°	100°
760	108·70	82·84	53·96	—	0·214	0·149	0·106	—
380	51·68	38·76	31·54	1·43	0·204	0·152	0·125	0·0117
300	40·20	30·60	22·20	—	0·201	0·1525	0·112	—
225	24·80	22·95	15·52	0·088	0·191	0·151	0·104	0·0118
180	22·30	16·58	10·52	—	0·181	0·137	0·089	—

A DITTE describes in *Compt rend.* a number of new fluorine compounds of uranium, the most important are $UF_6 . 8HF$ and UO_2F_2, produced by the action of hydrofluoric acid on the oxide U_3O_8, when the former compound is heated in a closed platinum dish it melts, gives off hydrofluoric acid and small quantities of the oxyfluoride UOF_4, which compound is produced in larger quantity by heating the above mentioned oxyfluoride, UO_2F_2, in a closed vessel. The hexfluoride UF_6 is produced by heating the double salt $UF_6 . 8HF$ in an open crucible Various double salts are also described, the general formula being $UO_2F_2 . 4MF$, where M may be K, Na, Li, Rb, or Tl.

CLEVE has made a redetermination of the atomic weight of the very rare metal erbium (*Compt rend.*). Assuming the formula of the oxide to be Er_2O_3, the atomic weight of the metal is 166. Pure erbia, Er_2O_3, is a beautiful rose-coloured earth, slowly soluble in acids, having a specific gravity of 8·64, and forming salts characterised by a deep-red colour; several of these salts are described by Cleve.

THE same author has succeeded in separating nearly pure *thulium*; this metal and its salts are colourless, but solutions of the salts show two absorption bands, one strongly marked in the red, and one broad band in the blue. The atomic weight of thulium is 129·6 or 170·7, according as the metal is regarded as di- or tri valent.

PHYSICAL NOTES

IT is stated that amongst the recent discoveries of Prof. Bell in connection with the photophone research is the interesting fact that melted sulphur conducts electrically like selenium, but only at temperatures below that at which it thickens and becomes dark and viscid.

THE *Comptes rendus* for November 2 informs us that Prof. Graham Bell and M. Janssen have attempted to *hear* with the photophone the sounds believed to accompany the rapid commotions taking place in the solar photosphere The experiments were made at the Observatory of Meudon, a selenium cylinder being placed in different parts of an image of the sun some two feet in diameter. No very conclusive results were obtained, but M. Janssen has further suggested that a sort of concentrated effect might be obtained by passing a number of successive photographs of a sun spot across a beam of light, the variations of the intensity of the beam producing sounds when they fall upon the sensitive "photophonic pile" of selenium. Some experiments in furtherance of this suggestion are now proceeding.

HAVING undertaken a series of researches upon the rapidity of evaporation of liquids, in dependence from the cohesion of molecules on their surfaces, M. Sreznevsky has measured how this rapidity varies with the variations of the height of the meniscus. He has established that, the diameter of the meniscus remaining invariable, the rapidity of evaporation increases as the height of the meniscus diminishes, that is, as its radius increases. There is however an anomaly as to this last law for distilled water: when the evaporation is measured in a meniscus the height of which is greater than the radius of its basis, the rapidity of evaporation increases throughout, however the radius of the meniscus begins by diminishing, and increases only after having passed through a minimum, but this minimum does not have a corresponding minimum in the rapidity of evaporation.

AT the recent meeting of the Helvetic Society of Natural Sciences M. Forel described a *thermal bar* which is developed in winter parallel to the shore of a lake of fresh water, and which separates the pelagic from the littoral region. The water of the former region remains long, and in some lakes always, at a temperature above 4° C, in the littoral region, if the winter be cold, the temperature descends between 4° and zero; and between the two there is a band of water at 4°, descending to the bottom —a kind of mountain with crest parallel to the shore and a talus on either side.

M. DUFOUR described at the same meeting an apparatus for indicating the variations of chemical intensity of the sunlight. It has some likeness to Draper's tithonometer; the principle is, opposing the variable action of light on a mixture of chlorine and hydrogen, with an electric current (of variable intensity, and measurable each instant), which by its passage causes decomposition of a quantity of hydrochloric acid equal to that produced by action of the light on the mixture of chlorine and hydrogen. The apparatus is like a Rumford differential thermometer; in one bulb is some hydrochloric acid solution, with carbon electrodes, in the other some sulphuric acid. The light acts on the former One mode of measurement is to note the time taken in displacement of the sulphuric acid column a certain distance along the connecting tube Then bring back the column to its original position by passing the current.

M PICTET has lately made experiments (*Arch. de Sci.*) as to the dissolving power of gases and vapours on one another. Various solutions of alcohol and water were successively put into one of two glass balloons connected by a tube; pressure was diminished with an air-pump, so that the space became filled with vapours from the mixture. By closing the tapered point of the second balloon with the blowpipe, the apparatus allowed of distillation being effected with small differences of temperature. Plunging successively the balloon that held the solution in water at from 0° to 80°, and the other in water only 1° or a fraction of a degree below that of the liquid, M. Pictet got condensed products, the quality of which indicated what "affinity of solution" existed between water and alcohol. The following conclusions were arrived at: The weight of condensed liquid is proportional, in unit time, to

the *difference of temperature* between the liquid in ebullition and the condensed liquid. The weight of liquid condensed in unit time is independent of the interior pressure or of the mean temperature during distillation. Analysis shows that the gases have no power of solution on one another. M. Pictet was thus led to an industrial process for rectification of spirits.

GEOGRAPHICAL NOTES

AT the meeting of the Geographical Society on Monday, Sir Bartle Frere read what may best be described as a suggestive paper on Temperate South Africa as a route to the Central Equatorial Region. After defining the temperate region as the vast tract of country extending to Cape Frio on the Atlantic coast and to the mouth of the River Tugela on the opposite side of the continent, and giving a brief account of its geography, &c., Sir Bartle addressed himself chiefly to the task of pointing out how it could be made available as a base of operations in exploring the country north of the Zambesi, and suggesting agencies which might be turned to account for the extension of geographical knowledge. These agencies are the traders and hunters, who have a wide acquaintance with many regions otherwise unknown, and missionaries of various denominations. The latter have no less than eighty-four fixed stations beyond the colonial boundaries, manned by 812 Europeans, many of whom are highly cultivated and intelligent men, and have great opportunities for acquiring geographical information. Sir Bartle Frere also hoped that the Council of the Society might see their way to urging the Government to undertake a proper survey of the coast-line, as well as of the interior of the five colonies.

AT the meeting of the Berlin Geographical Society on November 6 the safe arrival of Dr. Lenz at Timbuctoo (by a route not before taken by any European) was announced. Two of his followers were lost in the desert, and two had gone back. Dr. Stecker (who lately went to Massowah with Herr Rohlfs) will, according to circumstances, either push through the Galla regions or to the East coast, or to the Great Lakes. Major v. Mechow reached a town on the Quanza, in the territory of the Hollo, about 200 km. from Malange on July 19, after great difficulties, especially in carriage of the boat. The natives were friendly throughout. A little above the place reached are the two last falls of the Quanza, between which is the mouth of the Cambo. The Major seems to have been the first white to visit these waterfalls. He was going to Lupung with a view to determine the course of the Quanza. Dr. Pogge and Lieut. Wissmann were also travelling in that region the same month, intending to reach Mussumba, the residence of the Muata Jambo; Dr. Pogge's object is to establish stations in the interior. Lieut. Wissmann will make journeys for topographical and collecting purposes. The Italian traveller, Dr. Matteucci, is seeking to reach Bornu from South Dar-For, going round Wadai and Bagirmi. *Inter alia* the Society resolved to memorialise the German Government to take part in the international project of systematic Polar investigation.

AT the sitting of November 19 of the Société de Géographie of Paris M. Zweifel received the palm of Officer of the Academy as a reward for the discovery of the sources of the Niger, in company with M. Marius Moustier. The laureate declining to speak himself, an address was delivered on behalf of him and his companions by Dr. Harmand, the well-known explorer of Cochin China. It appears that MM. Zweifel and Moustier saw a granite rock from which the powerful stream takes its rise, but they were not admitted to the site, owing to the high priest of Tembi Saleb, who inhabits an island situated on a small lake formed by the stream at a very few miles from its source. So something more remains to be done to complete the work begun by Laing, Reade, and Blyden.

SIR ALLEN YOUNG leaves England next month in his yacht, and will visit, among other places, the Canary Islands, a portion of the West Coast of Africa, and St. Helena, extending his voyage as far as the Cape, where he will make preparations and inquiries for a projected expedition of discovery to be undertaken by him to the Antarctic regions. It will be remembered that the *Erebus* and *Terror*, commanded by Sir J. Ross and Capt. Crozier, penetrated in 1841 to 78° 4′ S., a latitude which has never been reached before or since.

THE November number of *Petermann's Mittheilungen* has a long paper by Spiridion Gopčević, containing his ethnographical studies in Upper Albania. A very fine map embodies the important results of Severzov's exploration of the Pamir in 1878, with accompanying text, followed by an account of Lieut.-Col. Pjevzov's journey through Mongolia in 1878-9, to Kuku-Choto and Kalgan. A summary is given of the Arctic work of 1880, followed by the usual monthly notes.

THE first *Bulletin* of the recently-formed International Geographical Institute at Berne consists of a programme of the projected Italian Antarctic Expedition under Lieut. Bone, which is to leave Genoa in March 1881. A sketch is given of what has been previously done in this region, showing that the field is practically virgin so far as scientific work is concerned. The programme of the Italian expedition is very comprehensive, and the ultimate object is to pave the way for the establishment of an Antarctic observing station.

No. 3 of vol. iii. of the *Deutsche geographische Blätter*, the organ of the Bremen Geographical Society, contains the continuation of the unfortunate Dr. Rutenberg's journal in Madagascar, and the lecture given at the Danzig meeting of the German Association by Dr. Neumayer on "Polar Expeditions or Polar Research?" To the latter able lecture we referred last week, the point insisted on being that while the two are perfectly congruous, the former should be subjected to the latter, which must be carried out on the system of Polar observatories advocated by Weyprecht, and to which nearly every civilised nation adheres except England.

THE new number of the Marseilles Geographical Society's *Bulletin* contains a very voluminous account by Messrs. Zweifel and Moustier, of their expedition to the sources of the Niger. This memoir is illustrated by a map showing their route, and supplemented by an appendix containing information as to the natural resources of the country traversed, the races of the interior, &c.

THE last part of *Le Globe* contains a paper (with map) on the Island of Cyprus, by M. Paul Chaix, and some account of recent researches in the Pamir, furnished by M. Veniukoff.

IN the current number of *Les Missions Catholiques*, M. Armbruster has commenced a series of papers on Corea, drawn from information furnished from time to time by the Romish missionaries, the only Europeans who have ever had any opportunity of acquiring a real knowledge of the interior.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The preliminary examination in the Natural Science School begins on Monday next, November 29. The Final Honour School begins on Monday, December 6.

The Brakenbury Scholarship in Natural Science at Balliol College has been awarded to Mr. William Stroud, from Owens College, for proficiency in physics and chemistry. *Proxime accessit* Mr. A. D. Hall, from Manchester Grammar School. Mr. J. J. Hart, Manchester Grammar School, and Mr. J. E. Marsh of Balliol, are honourably mentioned.

ON A METHOD OF DETERMINING THE CRITICAL TEMPERATURE FOR ANY LIQUID AND ITS VAPOUR WITHOUT MECHANISM[1]

A PIECE of straight glass tube—60 centimetres is a convenient length—is to be filled with the substance in a state of the greatest purity possible. It is to contain such a quantity of the substance that, at ordinary atmospheric temperatures, about 3 or 4 centimetres of the tube are occupied by steam of the substance, and the remainder liquid. Fix the tube in an upright position, with convenient appliances for warming the upper 10 centimetres of the length to the critical temperature, or to whatever higher or lower temperature may be desired, and for warming a length of 40 centimetres from the bottom to some lower temperature, and varying its temperature conveniently at pleasure.

Commence by warming the upper part until the surface of separation of liquid and steam sinks below 5 centimetres from the top. Then warm the lowest part until the surface rises

[1] By Sir William Thomson, British Association, Swansea, Section A, Tuesday, August 31.

again to a convenient position. Operate thus, keeping the surface of separation of liquid and solid at as nearly as possible a constant position of 3 centimetres below the top of the tube, until the surface of separation disappears.

The temperature of the tube at the place where the surface of separation was seen immediately before disappearance is the critical temperature.

It may be remarked that the changes of bulk produced by the screw and mercury in Andrews' apparatus are, in the method now described, produced by elevations and depressions of temperature in the lower thermal vessel. By proper arrangements these elevations and depressions of temperature may be made as easily, and in some cases as rapidly, as by the turning of a screw. The dispensing with all mechanism and joints, and the simplicity afforded by using the substance to be experimented upon, and no other substance in contact with it, in a hermetically sealed glass vessel, are advantages in the method now described. It is also interesting to remark that in this method we have continuity through the fluid itself all at one equal pressure exceeding the critical pressure, but at different temperatures in different parts, varying continuously from something above the critical temperature at the top of the tube to a temperature below the critical temperature in the lower part of the tube.

The pressure may actually be measured by a proper appliance on the outside of the lower part of the tube to measure its augmentation of volume under applied pressure. If this is to be done, the lower thermal vessel must be applied, not round the bottom of the tube, but round the middle portion of it, leaving, as already described, 10 or 20 cms. above for observation of the surface of separation between liquid and vapour, and leaving at the bottom of the tube 20 or 30 cms. for the pressure measuring appliance.

This appliance would be on the same general principle as that adopted by Prof. Tait in his tests of the *Challenger* thermometers under great pressure (*Proceedings*, Royal Soc. Edin., 1880), a principle which I have myself used in a form of depth-gauge for deep-sea soundings, in which the pressure is measured, not by the compression of air, but by the flexure or other strain produced in brass or glass or other elastic solid.

ABNORMAL VARIATIONS OF BAROMETRIC PRESSURE IN THE TROPICS, AND THEIR RELATION TO SUN-SPOTS, RAINFALL, AND FAMINES

IN the first part of his work on the Meteorology of the Bombay Presidency, which was submitted to Government in August, 1875, Mr. Charles Chambers pointed out that the variation of the yearly mean barometric pressure at Bombay shows a periodicity nearly corresponding in duration with the decennial sun-spot period (see "Meteorology of the Bombay Presidency," § 26, p. 12), and in August, 1878, in a letter to NATURE, vol. xviii. p. 567, I drew special attention to this relation, pointing out that the observations of the winter and summer half-years, separately as well as conjointly, show that the pressure is low when the sun-spot area is great, and *vice versâ*, but that the pressure curve *lags behind* the sun-spot curve.

In November of the same year the eminent physicist, the late Mr. John Allan Broun, regarding the relation thus established between the variations of barometric pressure and sun-spots as one of very great importance, in that it gave a probability to the existence of similar laws in the variations of other meteorological elements which he believed was previously wanting, communicated to the same periodical (NATURE, vol. xix. p. 6) an article in which he showed, from the observations recorded at Singapore, Trevandrum, Madras, and Bombay, that the years of greatest and least mean barometric pressure are probably the same for all India, and from this he inferred that the relation to the decennial sun spot period found for Bombay holds for all India.

In December, 1878, Mr. S. A. Hill supplemented and confirmed Mr. Broun's communication by giving similar data for Calcutta (NATURE, vol. xix. p. 432).

In May, 1879, Mr. E. D. Archibald communicated to NATURE, vol. xx. p. 28, the fact (brought to his notice by Mr. S. A. Hill) that at St. Petersburg the mean annual barometric pressure is high when the sun-spots are numerous, low when they are few, but that the pressure epochs lag behind the sun-spot epochs.

In December of the same year Mr. Blanford presented to the Asiatic Society of Bengal a paper (*Journal* of the Asiatic Society of Bengal, vol. xlix. part ii. 1880, p. 70) in which it was shown that the barometric observations recorded at Batavia from 1866 to 1878, at Akyab, Chittagong, and Darjeeling from 1867 to 1878, at Port Blair from 1868 to 1878, and at Singapore from 1869 to 1878, afford more or less confirmation of the results previously obtained for other stations in India.[1] And in the same paper Mr. Blanford brought forward the observations recorded at the Russian observatories at Ekaterinburg, Slatoust, Bogolowsk, and Barnaul from 1847 to 1877, and showed that at the two former stations during the whole period, and at the two latter during the first half of it, the barometric variations were similar to those previously obtained by Mr. Hill for St. Petersburg.

In a subsequent letter to NATURE, published in March, 1880, Mr. Blanford discussed the same observations in greater detail, dealing with the summer and winter observations separately, as well as conjointly, and showed that the decennial variation of the barometric pressure found for St. Petersburg was exhibited only by the observations of the winter months. He also obtained similar results for Ekaterinburg and Barnaul, but he appears to have overlooked the very important facts that the range of the winter curves rapidly decreases in passing from St. Petersburg, through Ekaterinburg to Barnauland, that the summer curves for the two latter stations are, on the whole, of the *same* character as the summer curves of the Indian stations, as may be seen by comparing the dotted curves for Ekaterinburg and Barnaul, given in NATURE, vol xxi p. 48, with the summer curve for Bombay, given in vol. xviii. p. 568 of the same periodical. He also showed that the barometric curves for Batavia, Singapore, and Port Blair were, as at other Indian stations, of the same character both in winter and summer.

In 1873 and 1874 (see British Association Reports for those years) Mr. Meldrum showed that there was strong evidence of a connection between sun-spots and rainfall, and he has recently (see *Monthly Notice* of the Meteorological Society of Mauritius for December 1878) put this question beyond all reasonable doubt by showing that the mean yearly rainfall of Great Britain, the continent of Europe, America, India, and the Southern Hemisphere, varies in the same way as the sun-spots, being on the average great when they are numerous, small when they are few.

In my "Brief Sketch of the Meteorology of the Bombay Presidency"[2] in 1876, I pointed out that the abnormal variations of the monthly mean barometric pressure in that year were mainly variations in the intensity of the usual seasonal movements, although at least some portion of the variations influenced a wider area than the Indian monsoon region, and in the Sketch for 1877 I attributed the uniformly high barometric pressure and the deficient rainfall of that year to a weak development of the equatorial belt of minimum pressure, probably induced by a diminution of the solar heat.

In the Report on the Meteorology of India in 1877 Mr. Eliot showed that the high pressure of that year was a characteristic of the whole Indian area and also of Australia.

In my meteorological sketch for 1878 I showed that the abnormal barometric movements observed at Zi-ka wei in China and at Manilla in 1878 were similar to those recorded in Western India; that the latter largely influenced the rainfall of the Bombay Presidency, and that in former years of deficient rainfall at Bombay the barometer had been relatively high, not only at Bombay, but also at Mauritius and Batavia.

In the paper (*Journal* of the Asiatic Society of Bengal, vol. xlix. part ii., 1880, p. 70) already quoted, Mr. Blanford has confirmed the fact that the excessive pressure observed in the Indian area in the years 1876 to 1878 extended to China and Australia, and he has also shown that it affected Western Siberia also.

In my sketch for the year 1879 I have shown that these uniform variations of barometric pressure are accompanied by a nearly uniform variation of the percentage rainfall of all portions

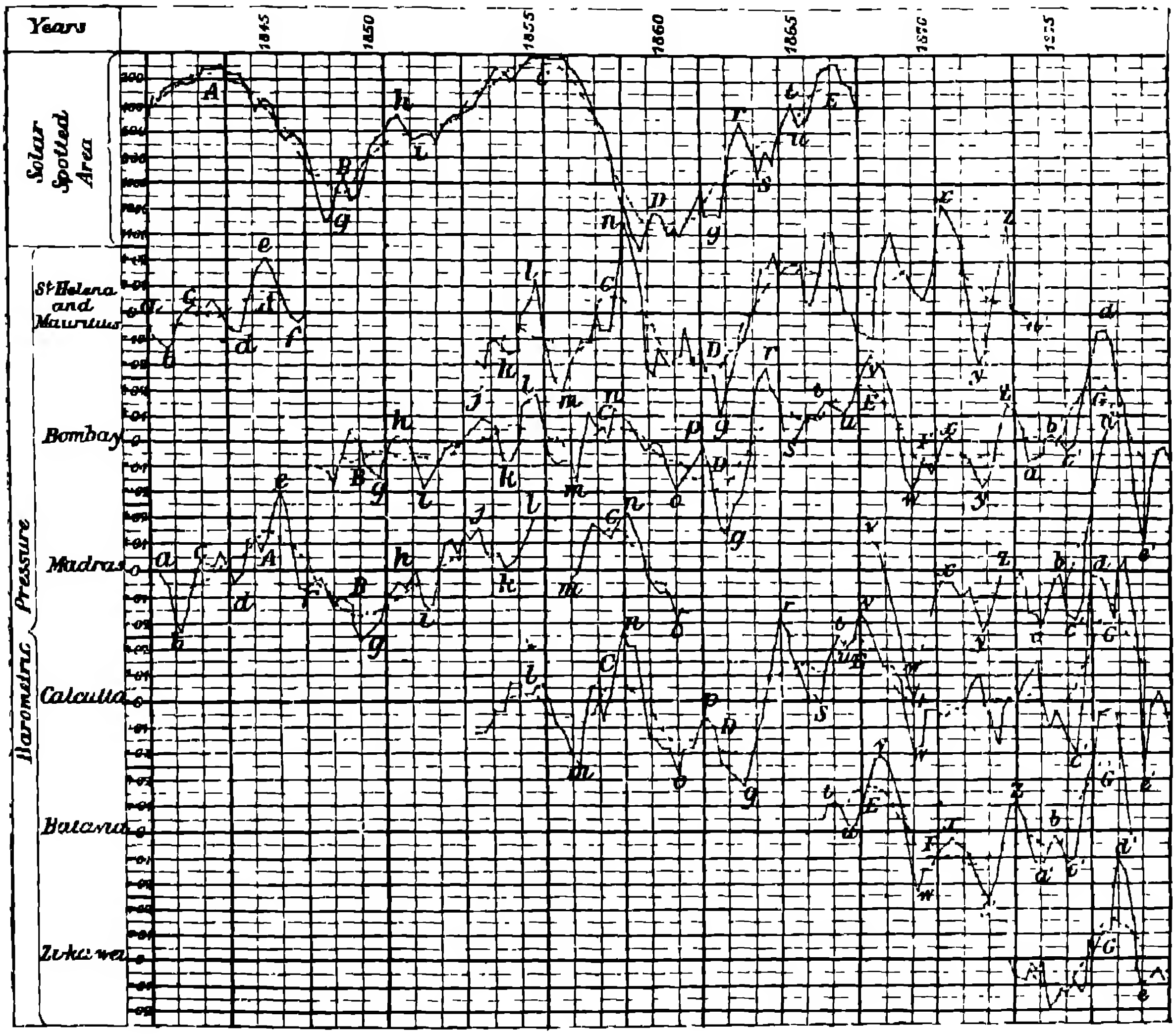
[1] During the first half of these periods the results for Singapore, Akyab, Chittagong, and Darjeeling differ so much from each other and from the remarkably accordant results obtained from the more widely separated stations of Bombay, Calcutta, Port Blair, and Batavia as to suggest that the former are of doubtful validity during the earlier years.

[2] These sketches are submitted annually to Government in August of the year following that to which they refer. See notices in NATURE, vol. xviii pp. 199 and 619, vol xxi p. 384. The sketch for 1879, containing some further important conclusions with reference to the variations of rainfall and barometric pressure, has recently been submitted to Government.

of the Bombay Presidency, and that the proportionate increase or decrease of the abnormal rainfall, corresponding to a fall or rise in the abnormal pressure of a tenth of an inch of mercury, amounts to more than *one hundred per cent.* of the normall fall, but that the variations of the ordinary monsoon gradients produce very different effects on the rainfall of different districts, depending on the geographical peculiarities of the particular locality.

From all these facts it is clear that there is some intimate relation between the variations of sun-spots, barometric pressure, and rainfall; and as famines in general are induced by a deficiency of rain, it is probable that they also may be added to the above list of connected phenomena. What is required in order to gain an insight into the causal relation of these variations is that they should each and all be studied in greater detail than has hitherto been attempted. Accordingly I commenced, more than a year ago, a detailed investigation into the nature of the abnormal variations of barometric pressure, and have been led to the discovery of some new facts which appear to me to be of sufficient importance to render it desirable that they should be published in anticipation of the theoretical conclusions deducible therefrom.

Commencing with the daily abnormal barometric variations observed at several stations in Western India, it was soon found that as the time over which an abnormal barometric fluctuation extended became longer and longer, the range of the fluctuation became more and more uniform at the various stations, thus leading to the conclusion that the abnormal variations of long



duration affect a *very wide area*. To test this inference it became necessary to compare the observations recorded at Bombay with those of some distant tropical station. Batavia was chosen, and on curving the daily observations side by side with those of Bombay, the degree of accordance between them was found to be truly surprising, considering how far the two stations are apart. The next step was to compare the monthly abnormal variations of these two stations, and finding that they presented many similar features, as well as some differences, to smooth the variations by taking three-monthly means. The degree of accordance was now found to be still greater, many of the discordances having been eliminated in the process of smoothing; but as some differences were still observable the process was repeated, giving nine-monthly means of abnormal pressure corresponding to the middle of the months January, April, July, and October of each year. The curves obtained in this way for Bombay and Batavia were then found to be *almost identical in form*, but with this very remarkable difference: *the curve for Batavia was seen to lag very persistently about one month behind the Bombay curve*. Similar results were then worked out from all the available data for the following tropical stations: St. Helena, Mauritius, Madras, Calcutta, and Zi-ka-wei, and for comparison with them the monthly sun spot areas[1] were treated in exactly the same manner. The results are given in the following table, and graphically represented by the continuous curves on the annexed plate:—

[1] Taken from the paper by Messrs De La Rue, Stewart, and Loewy, published in the *Philosophical Transactions* for 1870, p. 122.

TABLE I.

Nine-Monthly Means of Solar Spotted Area and Abnormal Barometric Pressure

Year		Solar spotted area in millionths of visible hemisphere	Abnormal barometric pressure in thousandths of an inch					
			St. Helena	Bombay	Madras	Calcutta	Batavia	Zi-ka-wei
1841	1	473	- 5					
	2	354	- 8					
	3	359	- 12		- 1			
	4	285	- 14		7			
1842	1	241	- 11		- 18			
	2	207	- 3		- 23			
	3	236	+ 1		14			
	4	209	+ 3		- 2			
1843	1	188	+ 2		+ 4			
	2	116	+ 2		+ 3			
	3	107	+ 5		+ 2			
	4	102	+ 2		+ 8			
1844	1	130	- 5		+ 1			
	2	177	- 7		- 5			
	3	178	- 8		- 1			
	4	265	+ 2		+ 11			
1845	1	374	+ 10		+ 14			
	2	423	+ 17		+ 8			
	3	360	+ 21		+ 13			
	4	407	+ 16		+ 25			
1846	1	556	+ 11		+ 30			
	2	657	+ 3		+ 23			
	3	611	- 1		+ 7			
	4	664	- 3		- 6			
1847	1	719	- 1		- 7			
	2	841			- 4			
	3	1110		10	- 2			
	4	1295		- 12	- 10			
1848	1	1251		- 16	- 13			
	2	1053		12	- 11			
	3	969		- 3	- 11			
	4	1144		+ 4	- 13			
1849	1	1096		0	- 26			
	2	962		- 8	- 24			
	3	761		- 12	- 22			
	4	672		- 14	- 20			
1850	1	618		- 6	- 12			
	2	526		0	- 9			
	3	492		+ 2	- 4			
	4	588		0	- 6			
1851	1	671		- 5	- 3			
	2	669		- 10	0			
	3	633		- 19	- 13			
	4	627		- 15	- 13			
1852	1	659		- 10	- 5			
	2	566		- 3	+ 10			
	3	510		- 1	+ 12			
	4	456		- 2	+ 4			
			Mauritius					
1853	1	474		0	+ 14			
	2	448		+ 3	+ 11			
	3	412	- 19	+ 8	+ 16	- 12		
	4	323	- 21	+ 10	+ 6	- 10		
1854	1	213	- 12	+ 8	+ 7	- 7		
	2	123	- 11	+ 6	+ 7	- 3		
	3	155	- 14	- 7	+ 1	- 3		
	4	202	- 16	- 7	+ 3	+ 7		
1855	1	175	- 15	- 1	+ 6	+ 9		
	2	100	- 2	+ 13	+ 12	+ 4		
	3	17	+ 3	+ 17	+ 20	+ 3		
	4	16	+ 12	+ 19		+ 6		
1856	1	16	- 2	+ 6		+ 7		
	2	30	- 15	- 5		+ 1		
	3	26	- 27	- 9		- 9		
	4	45	- 31	- 7		- 11		

Year		Solar spotted area in millionths of visible hemisphere	Abnormal barometric pressure in thousandths of an inch.					
			Mauritius	Bombay	Madras	Calcutta	Batavia	Zi-ka-wei
1857	1	86	- 21	8	- 3	- 19		
	2	130	- 17	- 16	- 1	- 24		
	3	234	- 12	- 1	+ 9	- 6		
	4	369	- 11	+ 12	+ 18	+ 5		
1858	1	510	0	+ 7	+ 16	+ 8		
	2	581	- 7	+ 6	+ 15	- 7		
	3	798	- 7	+ 2	+ 13	+ 2		
	4	1046	+ 7	+ 13	- 19	+ 11		
1859	1	1137	+ 32	+ 10	+ 21	+ 27		
	2	1222	+ 35	+ 8	+ 22	+ 22		
	3	1436	+ 20	+ 4	+ 15	+ 21		
	4	1519	- 6	- 3	+ 8	+ 3		
1860	1	1340	- 21	- 1	- 3	- 13		
	2	1231	- 25	0	- 5	- 15		
	3	1266	14	2	- 8	- 18		
	4	1405	- 21	- 11	- 8	- 18		
1861	1	1365	- 18	- 19	19	- 28		
	2	1416	18	- 16	- 14	- 18		
	3	1343	- 6	11	- 16	- 18		
	4	1238	- 18	- 8		- 13		
1862	1	1063	- 14	- 2		- 8		
	2	1275	- 23	- 9		6		
	3	1254	- 24	22		- 10		
	4	1267	41	- 34		- 23		
1863	1	913	31	- 37		- 26		
	2	684	- 23	- 26		- 28		
	3	508	- 12	- 21		- 32		
	4	652	0	- 7		- 23		
1864	1	757	0	+ 14		- 14		
	2	985	+ 16	+ 24		- 7		
	3	783	+ 17	+ 29		+ 8		
	4	838	+ 24	+ 20		+ 20		
1865	1	598	+ 16	+ 14		+ 32		
	2	511	+ 18	+ 2		+ 28		
	3	377	+ 19	+ 1		+ 18		
	4	541	+ 19	+ 1		+ 11		
1866	1	517	+ 5	+ 9		+ 1		
	2	406	+ 4	+ 9		+ 2		
	3	174	+ 12	+ 12		- 1	+ 6	
	4	101	+ 31	+ 15		+ 14	+ 11	
1867	1	74	+ 31	+ 14		+ 20	+ 11	
	2	70	+ 18	+ 13		+ 25	+ 10	
	3	209	+ 1	+ 11		+ 20	+ 4	
	4	261	0	+ 15		+ 22	+ 4	
1868	1	415	- 7	+ 24		+ 33	+ 16	
	2		- 8	+ 29		+ 31	+ 22	
	3		- 10	+ 33	+ 11	+ 25	+ 28	
	4		+ 14	+ 31	+ 9	+ 16	+ 30	
1869	1		+ 26	+ 27	- 1	+ 14	+ 27	
	2		+ 31	+ 19	- 11	+ 14	+ 20	
	3		+ 22	+ 5	- 24	+ 9	+ 10	
	4		+ 16	- 15	- 44	- 6	- 6	
1870	1		+ 13	- 19	- 49	- 17	- 16	
	2		+ 8	- 15	- 43	- 16	- 24	
	3		+ 5	- 6	- 24	- 3	- 14	
	4		+ 12	- 11	- 16	- 3	- 13	
1871	1		+ 27	- 9	- 9	- 4	- 7	
	2		+ 42	- 1	- 4	- 5	- 5	
	3		+ 39	+ 2	- 4	- 2	- 2	
	4		+ 33	0	- 8	- 2	- 4	
1872	1		+ 27	- 6	- 10	- 2	- 7	
	2		+ 9	- 7	- 6	+ 7	- 9	
	3		- 3	- 12	- 16	+ 11	- 17	
	4		- 20	- 18	- 23	- 1	- 24	
1873	1		- 15	- 15	- 19	- 4	- 26	
	2		+ 7	- 8	- 11	- 17	- 17	
	3		+ 18	+ 6	- 2	- 1	- 4	+ 2
	4		+ 34	+ 15	- 1	+ 2	+ 10	0
1874	1		+ 2	+ 12	- 3	+ 2	+ 12	- 6
	2		0	+ 5	- 1	+ 8	+ 5	- 8
	3		- 2	- 7	- 15	+ 12	- 4	0
	4			- 6	- 16	+ 16	- 11	- 4

TABLE I. (*Continued*)—

Year		Solar spotted area in millionths of visible hemisphere.	Abnormal barometric pressure in thousandths of an inch: Mauritius.	Bombay.	Madras.	Calcutta	Batavia	Zi-ka-wei
1875	1			− 5	−22	+ 2	−11	0
	2			+ 1	−11	−10	− 7	−18
	3			+ 2	− 4	− 3	− 1	−16
	4			+ 1	− 1	− 9	− 5	−12
1876	1			− 3	−16	−14	−11	−13
	2			− 1	−18	−19	−10	− 8
	3			+ 9	−13	− 3	+ 1	−12
	4			+21	+12	+27	+22	+ 8
1877	1			+29	+30	+49	+28	+ 4
	2			+43	+46	+48	+46	+11
	3			+43	+55	+43	+47	+12
	4			+38		+32	+49	+29
1878	1			+24		+51	+34	+39
	2			+13		+55	+17	+34
	3			−15		+33	− 1	+16
	4			−33		0		− 4
1879	1			−40		−26		−10
	2			−15		− 2		− 7
	3			− 4		+ 4		− 3
	4			− 1		− 2		− 8
1880	1			− 8		−14		

Comparison of Abnormal Barometric Movements at Different Stations.—The general resemblance of all these curves to each other is very remarkable, indeed if the Mauritius curve for the years 1867 and 1868 be excluded, there is scarcely a single prominent feature in any one of the curves which is not reproduced in the others. To show this the corresponding points of the different curves have been marked with the same small letters It will be seen, however, that there is strong evidence of a want of exact simultaneity in the barometric movements at different stations, and that as a rule the changes take place at the more westerly stations *several months earlier* than at the more easterly ones. This is particularly noticeable in the curves for St. Helena and Madras from 1841 to 1846, when the latter sometimes lagged behind the former by as much as six months, in those for Mauritius and Calcutta from 1855 to 1866, when the latter persistently lagged several months behind the former, in those for Bombay and Calcutta from 1862 to 1866, when the difference in time often amounted to *upwards of six months*, in those for Bombay and Batavia from 1867 to 1878, when (as already remarked) the latter lagged behind the former at an average interval of about one month, and in those for Bombay and Ti-ka-wei from 1876 to 1878, when the latter lagged upwards of six months behind the former. *It appears then that these long atmospheric waves (if such they may be called) travel at a very slow and variable rate round the earth from west to east, like the cyclones of the extra tropical latitudes*

Bombay FRED. CHAMBERS

(*To be continued*)

DR SIEMENS'S NEW CURE FOR SMOKE

FROM among a number of letters which have been sent us on this subject we have selected the following for publication, to these Dr. Siemens has been good enough to append some important remarks

IN NATURE, vol xxiii. p. 25, I read with interest an article by Dr. Siemens describing an ingenious gas and coke fire which he suggests as a cure for the smoke nuisance. But although the darkening of the atmosphere or fog will certainly be prevented by its use, I am afraid the *gases from the coke*, especially the carbonic oxide, will make the fogs at least as poisonous and injurious to health as the open coal fires at present in use.

In these circumstances a description of an "Asbestos gas fire" free from this objection, which we have had in use in our smoking room for the last three years, and which, after a few alterations, has proved perfectly satisfactory, may perhaps interest your readers.

A ½-inch gas-pipe furnished with four Bunsen burners is laid on the hearthstone under the grate and parallel to the ribs, so arranged that the tops of the burners (which are made elliptical to pass through the bars) are flush with the upper surface of the grate, and two inches back from the line of the ribs. The fire-place is loosely filled with a preparation of asbestos in pieces about the size of a hen's egg.

This fire not only evolves a large amount of heat, but has a very cheerful appearance, similar to that of a bright coke fire, and to insure this it is essential that the burners should be placed close to the ribs, as stated above, and not in the centre of the grate. If this is not attended to the asbestos in the centre of the fire will be raised to a high temperature, but will not be sufficient to heat those portions in front, which will then not only be of no use as radiators in themselves, but act as screens to the light and heat generated in the centre. I suspect this was the cause of the failure of Dr. Siemens' pumice gas fire.

The cost of maintaining this fire is simply that of the amount of gas burned, as the asbestos is not consumed, and its prime cost is trifling I have only further to add that there is not the slightest trace of fumes or smell from the fire two minutes after it is lighted. D. A. STEVENSON

Edinburgh, November 15

DR. SIEMENS has described in your pages the form of coke-gas grate which he has fitted in his own house. As I had fitted a similar arrangement in this house before Dr. Siemens' letter appeared in the *Times* of November 3, and as it is simpler than Dr Siemens' and succeeds even beyond my expectation, I send you a drawing and description of it. It varies, of course, according to the shape of the grate in which it is fitted, but for the sake of comparison I have copied Dr. Siemens' grate, and drawn my arrangement as fitted into it

Instead of Dr. Siemens' arrangement for withdrawing the heat from the back of the fire and bringing it to the front, I merely line the whole grate—sides, back, and bottom—with fire-bricks This obviates the necessity for the close-fitting ash-pan described by Dr Siemens, which would be rather expensive to fit. I make the fire-brick in the bottom of the grate slope towards the front, and leave a space of one inch between the front of it and the perforated gaspipe down which space the ashes fall on to the hearth.

If my grate is not quite so economical in working as Dr. Siemens', it is very near it, and the first cost of fitting is considerably less. In fact, as most grates are lined with fire-brick at back and sides, nothing has to be done but fit a wedge shaped fire-brick into the bottom, a half-inch iron gaspipe, perforated with holes in front, and connect it with the gas service, all of which can generally be done for a few shillings.

The saving of kindling wood and of chimney-sweeping would pay for it in a year. In Dr Siemens' grate the copper must cost about *1l* A grate fitted with this arrangement looks exactly the same as an ordinary grate, and there is nothing to prevent ordinary coal being burnt in it—in fact coal can be burnt in it with much less smoke than in an ordinary grate by turning on the gas for a few minutes when fresh coal is put on, when the dense black smoke emitted by the new coal is completely burnt up in the gas flame. To people who object that a gas grate must produce a bad smell in the room I can only say, "Come and see." They will find that we have three grates with this arrangement in constant use in these chambers, and that they produce no smell and make a very pleasant fire. Any person who takes an interest in the subject is quite welcome to come in and look at them at any time. COSMO INNES

Adelphi Chambers, 7, John Street, Adelphi

HAVING been experimenting for some years in the direction referred to by Dr. Siemens in NATURE, vol xxiii p. 25, I must beg to differ with him most seriously in some of his conclusions. The gas-fire with coke which he describes has, so far as our experience goes, several practical objections which prevent its use in the place of an ordinary gas fire, whilst when compared with a *good* coal fire it fails seriously.

First, with regard to the objections to Dr. Siemens' fire. It requires about half an hour to become anything like warm, as against ten to fifteen minutes with a well-lighted coal fire. Second, it makes as much or more dust and dirt than a *good* coal fire Third, the grate requires as much cleaning and care as with coal

I am not surprised at the economy, comparing the coal fire as shown with gas and coke, but if the result had been taken in

comparison with a good Abbotsford grate with solid clay bottom, back and sides, the figures would have appeared seriously the other way.

In a room of exactly half the cubic area of the one referred to by Dr Siemens we have an Abbotsford grate a little over ⅓rd cubic foot capacity, the actual measurement of the fire space being 5½ inches deep, 8 inches back to front, 14 inches wide. This is lighted at 7 o'clock every morning and at 10 o'clock the grate is filled (not piled high). This fire burns until 10 or 11 o'clock every night untouched, practically smokeless, making the room pleasantly warm all over in the severest weather, and without making a *handful of cinders in a month*. One ordinary boxful of coals lasts two days. We have five, sometimes six, fires going daily at an average cost for coal for the winter season of five shillings weekly, or less than twopence per day per fire That Dr. Siemens is correct so far as the old style of fire grate is concerned, I know to my cost, but taking any good grate with clay sides and back and a solid clay bottom, his fire at its best will not compare either for cleanliness, economy, or comfort.

Gas fires are wanted where absolutely no attention and dust can be permitted. Allowing either of these as possible, no substitute I know will approach a well-constructed open fire with a solid clay bottom and fire-box

With regard to the waste heat, it is no greater than absolutely necessary to take away the products of combustion, as, with our grates, it is utilised for warming the upper rooms. At this moment, with five good fires, there is visible from the tops of our chimneys nothing except a clear transparent current of warm air, any one at a cursory glance would say there were no fires in the house.

It must be borne in mind when I refer to cost that we cook entirely by gas, and the price of good coal here is 14*s*. 2*d*. per ton, coke being about half this price. What is required in a gas fire is a perfectly clean source of radiant heat, without trouble, and quickly available these conditions are not in any way fulfilled by Dr. Siemens' arrangement. With the exception of two or three minutes expended in lighting, all he has attained can be found in a more perfect form in many of the fire-grates which have been in common use for the last ten years Amongst our many attempts at gas fires one, although not absolutely the same as Dr. Siemens', was practically so, and was condemned because it required as much trouble as our present fires, and was much slower in lighting It would be both interesting and instructive if Dr. Siemens would test an Abbotsford grate under the same conditions as his coke gas fire, and supplement his report with one from the individual who has to do the cleaning up and dusting, a department which it is more than probable he ignores

Another important matter is that I believe the cost of making and fixing Dr Siemens' grate would be not less than that of a good modern fire-grate. THOS. FLETCHER

Warrington

THROUGH your courtesy I am enabled to reply to the objections raised by three correspondents against my proposed gas-coke grate, before they have actually appeared in your columns.

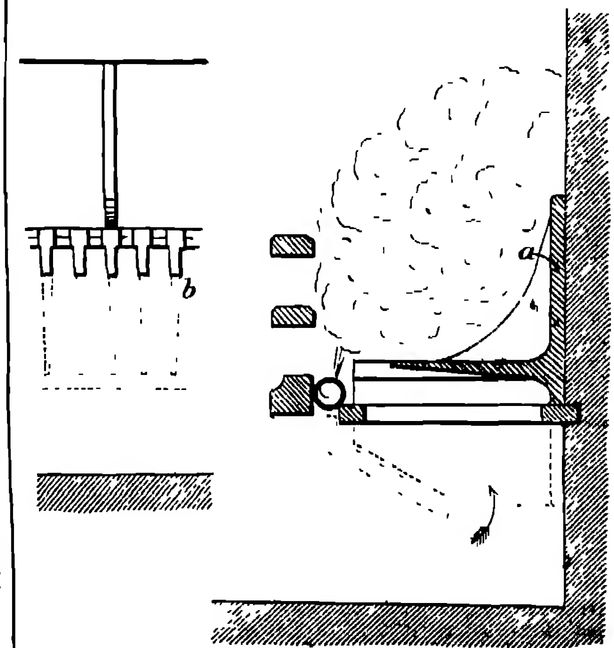
Mr. D. A. Stevenson considers that the use of coke is objectionable on account of the gases evolved in its combustion, and especially the carbonic oxide gas, which would poison the atmosphere. In reply I have to say that in burning coke with a supply of hot air, and in contact in front of the grate with the atmosphere, its entire combustion is insured, resulting in carbonic acid, which is a necessary constituent of our atmosphere In obtaining the same amount of heat through the perfect combustion of gas, products of combustion at least equally objectionable from a sanitary point of view will be evolved.

The gas-asbestos grate which he describes appears to be judiciously contrived, but its power of heating the room depends entirely upon the combustion of gas unaided by hot air or solid fuel. Now 1000 cubic feet of gas weigh about 34 lbs., and the heat developed in the combustion cannot exceed $34 \times 22{,}000 = 748{,}000$ units of heat.

The heat units produced in burning a pound of coke may be taken at 13,400 (assuming it to contain about 8 per cent. of incombustible admixture, the heat equivalent of pure carbon being 14,500 units), and it requires $\frac{748{,}000}{13{,}400} = 56$ lbs., or just half a hundredweight of this coke, to produce the heating effect of 1000 cubic feet of gas.

Taking gas coke at 18*s*. per ton (which is an excessive price), the 56 lbs. of coke represent a cost of 5·4*d*., as compared with 3*s*. 6*d*. for the 1000 cubic feet of gas producing the same amount of heat. This great difference of cost at once shows the advantage of making coke do as much of the work as possible. Without it a gas grate will consume 50 to 70 cubic feet of gas per hour, whereas my experiments prove that an average consumption of 8 cubic feet suffices to heat a large room when combined with a moderate consumption of coke, and with the use of the heating arrangement, to which I attach great importance. Another important consideration in favour of the joint use of coke and gas is that the existing gas companies produce both these constituents very much in the proportion in which they would be required, and could therefore provide the means of supplying an enormous number of coke-gas grates, whereas their plant and mains would be quite inadequate to supply a demand upon them for an extended application of purely gas stoves.

Mr. Cosmo Innes describes a gas grate of his construction, having the closed grate and single gas pipe behind the lower front bar which I advocate; he proposes to fill the grate with common coal, using the gas only as a means of kindling the fire. My objections to his proposal are that in using coal he must continue to make smoke, which we are desirous to prevent, and that the hot back to his fire means rapid distillation of the fuel up the chimney in the form of hydrocarbons and carbonic oxide. The gas arrangement as shown by him will be efficacious, no doubt, as a means of kindling a bright and cheerful fire, but he



would do better in that case to use a few logs of wood instead of coals A bright but short-lived fire may thus be raised quickly at a cheap rate in a dining-room or in a parlour.

Mr. Thomas Fletcher admits that my grate has the advantage of economy over a common coal grate, but thinks the Abbotsford grate the best of all. This grate is according to him practically smokeless, and produces only a handful of cinders in a month, although common coal is used Now I have no desire to detract from the merits of the Abbotsford grate, but I fail to see why it should be smokeless, considering that raw coal is used; and the extremely small production of ashes or cinder seems to imply that Mr. Fletcher uses an extremely pure and probably a smokeless coal, very different from the fuel we are usually supplied with in London.

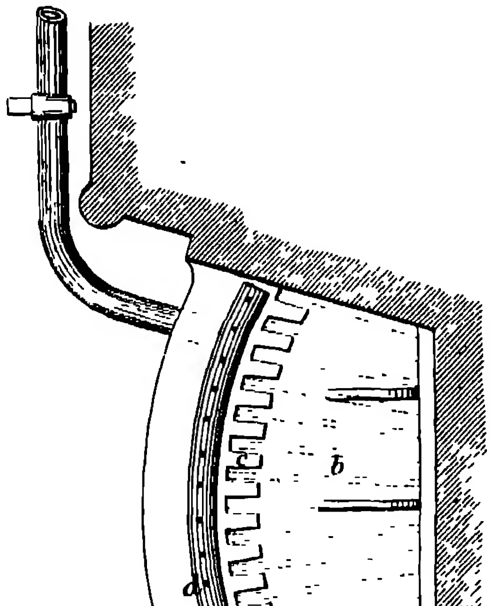
He also objects to the cost of my arrangement, and his opinion in this respect, coming from a practical grate-builder, is entitled to every consideration. In first describing my plan I did not go into the question of cost of application; but having been since asked by grate-builders to advise them regarding the cheapest form of my grate and the easiest mode of applying it to existing fire-places, I have devised a form of application which leaves little to be desired, I think, as regards first cost.

The arrangement is shown by the accompanying sketch, and consists of two parts which are simply added to the existing

grate, viz.:—(1) the gas-pipe (d) with holes of about $\frac{1}{16}$ inch diameter, 1·5 inch apart along the upper side inclining inward, and (2) an angular plate (a) of either cast or wrought iron, with projecting ribs (b) extending from front to back on its underside, either cast with or riveted to the same, presenting a considerable area, and serving the double purpose of supporting the additional part on the existing grate, and of providing the heating-surface produced by the copper plate and frill-work in my first arrangement. In using iron instead of copper it is necessary however to increase the thickness of these plates and ribs in the inverse ratio of the conductivity of the two metals, or as regards the back plate, from $\frac{1}{4}$ inch to $\frac{5}{8}$ inch.

The arrangement will be rendered more perfect by the use of the bent plate fastened to the lower grate bar, which directs the incoming air upon the heating surfaces.

The front edge of the horizontal plate has vandyked openings (c), so as to form a narrow grating, through which the small quan-



tity of ashes that will be produced by combustion of the coke and anthracite in the front part of the grate discharge themselves down the incline towards the back of the hearth, where an open ash-pan may be placed for their reception.

In adapting the arrangement to new grates, the horizontal grating had better be dispensed with, and the casting with its lower ribs extended downwards, so as to find its fixed support between the back of the fireplace and the inclined deflector plate.

Mr. Fletcher speaks of the large amount of ashes that would be produced, but this amount can surely not be as great as in the case of a coal fire, seeing that the consumption of solid fuel is reduced to less than one-half, of which nearly one-half is anthracite, a fuel remarkably free from ashes. Neither do I participate in Mr. Fletcher's fear regarding opposition on the part of housemaids, except it be from an apprehension on their part that, with Othello's and the chimney-sweeps', their "occupation be gone."

The tendency of grate-builders of the present day, and also of your correspondents, appears to be to look for economy to brick-linings, which no doubt have the effect of producing hot radiating surfaces. I maintain however that such radiation is obtained at too great a cost of fuel, and that superior economical results will, on the contrary, be attained by abstracting the heat from the back of the fire, and concentrating it upon the purely carbonaceous material in front of the same.

To illustrate my reasoning I may here refer to an experiment which can easily be made of throwing a shovelful of bituminous coal into a steel-melting furnace; the result is an instantaneous dispersion of the coal, accompanied with a powerful refrigerative action on the furnace. In constructing gas-producers I take advantage of hot walls to turn solid into gaseous fuel, and a fireplace with hot brick bottom and sides is very much in the condition of a good gas-producer, giving out radiant heat no doubt, but combined with rapid distillation of combustible gases into the chimney. This action is made apparent in placing on the fuel towards the back of such a grate when in full glow a piece of wood, which will be seen to dwindle away rapidly without giving rise to flame, the atmosphere immediately over the glowing fuel being essentially a reducing one.

In my grate the heat, on the contrary, is confined to the coke immediately behind the bars, in contact with the heating gas flames and with the air of the room flowing in towards the chimney, whereas the coke at the back of the grate remains comparatively cool and unconsumed throughout the day. The cold furnace back also means a cold chimney, and it is rather remarkable to observe that in the case of the application at my office, a thermometer held high up into the chimney showed a temperature of only 130° F., while the front of the grate was in a high state of incandescence. These, I maintain, are conditions most favourable to economy combined with entire absence of smoke or deleterious gases. C. WILLIAM SIEMENS

12, Queen Anne's Gate, S.W., November 24

CURIOUS IMPRESSIONS IN CAMBRIAN SANDSTONE NEAR LOCH MAREE

IN course of the short excursion to Loch Maree and its neighbourhood, Mr. Walter Carruthers, of the *Inverness Courier*, happened, on June 13, to light upon an interesting portion of the Cambrian or Torridon Red Sandstone of the district, forming part of the bed of the burn, near Loch Maree Hotel, on which occur what have been called the Victoria Falls, so named from the fact that the Queen visited them. There an exposed surface of the rock about sixteen feet in length, nearly as much in breadth, and almost perfectly level, is marked by several double grooves quite discernible, and each divided by a very thin raised line. These traverse the whole length of the rock in a perfectly straight line, and on both sides of them are roughnesses which, if we could entertain the idea that the grooving had been caused by some living creatures, might be produced by footprints which have been to a great extent obliterated. The impressions were so striking that they immediately suggested a recollection of the footprints discovered in the sandstones of Morayshire and Tarbatness, though there was no other resemblance than their marked character on the broad, flat rock. Having heard that Mr. William Jolly, H.M. Inspector of Schools, was in the neighbourhood, Mr. Carruthers called his attention to the subject, and indicated where he should find the markings. Mr. Jolly was not slow to examine the spot, and he writes to Mr. Carruthers as follows, as given in the *Inverness Courier* of July 1:—

"I found your curious lines without difficulty, guided by your accurate description of their locality. They are assuredly no 'mare's nest,' but *bonâ fide* ancient impressions of some kind, which should receive the attention of geologists, both on their own account and as existing in the second oldest geological formation in Britain, in which, as yet in Scotland, no evidences whatever of organic life have been discovered.

"The lines or bands in question occur in the chocolate-coloured Torridon sandstone, the Cambrian of Murchison and Geikie, which is so well developed around Loch Maree, and rises into the great dome of the Slioch, or the Spear Head, that guards its waters. The most distinct of the impressions consists of two continuous flat bands side by side, $1\frac{1}{4}$ to $1\frac{1}{2}$ inch broad, and about a quarter of an inch deep, running quite straight across the flat layers of sandstone *in situ*, and perfectly distinct for sixteen feet, disappearing on the west side under the superincumbent rock, and broken only where portions of the sandstone have

been weathered out. In some places a third line runs alongside the two, but this is much less distinct and persistent. The double band resembles nothing more nearly than the hollow impression that would be left by double bars of iron placed closely together and neatly inserted in the rock for clasping some structure on it, if the iron were subsequently removed; or, as you suggest, the marks of a gouge driven by a carpenter across a board. The bands, when looked narrowly into, consist of very fine close hair-like lines, continuous and parallel to their sides, resembling very minute striæ left by glaciation, and look as if caused by some object drawn along the original red sand, before it became the present indurated rock.

"A similar double line runs parallel to this one, about two feet lower down, seven feet long, and a third parallel double line on the other or upper side, three feet long, both of the same breadth as the first. Besides those pointed out by you, which occur on the same flat of sandstone, other lines exist farther down, on the other side of the pool below this rocky flat, on a similar bed of sandstone, part of the same layer—one three feet in length, another six feet, running more or less parallel to those above. Indications of others may also be seen, and, no doubt, several more may be discovered on more careful examination.

"What they are I can scarcely even surmise, having seen nothing of the *same* kind elsewhere. They do suggest the possibility of their being the indentations of the caudal appendage of some huge creature, similar to the hollow tail-lines between the footprints on the sandstone at Tarbatness and along the shores of Morayshire—a suggestion strengthened by the fact of the existence, on both sides of the line, of numerous rounded hollow marks, very like the footprints on these reptiliferous rocks, occurring, as in them, at intervals. But the continuous even breadth and square section of the bands would seem to render this impossible. Then they might be the depressions left on the soft sand by the hinder portions of the shell of some large crustacean—a more likely cause, rendered more probable by the existence of very good ripple marks on the same sandstone, in the same and neighbouring layers. The striæ-like lines of which the grooves consist would seem to point to some moving agent, organic or physical. They may, however, be the casts or impressions of some great land reed or sea fucoid, the hair-lines being the marks of the fine structure of its stem or the parallel veins of its leaves. It would be desirable to have the superincumbent layer of rock carefully removed where the bands in question disappear under the upper rock, which might shed some light on the nature of the strange marks. I was sorry I could not spend more time on their examination."

The impressions occur about 300 or 400 yards above the Victoria Falls, and immediately beside the last of three lesser waterfalls on the west side of the stream.

THE QUANTITIES OF WATER IN GERMAN RIVERS

An attempt has recently been made by Herr Graeve (*Der Civil-Ingenieur*, 1879, p. 591) to determine the amount of water in German rivers and its apportionment in different seasons, a question very important for navigation, and also of much scientific interest. His research comprehends the chief rivers of Germany, excluding the Danube, which begins to be navigable only outside of Germany, and including the Vistula and the Memel. He first calculated, from the mean heights of water, the quantities of water flowing out per second, and he adds a table in which the amount of outflow is shown in relation to the extent of the corresponding river territory. When the amount of outflow per 100 sq. km. of the region of precipitation is calculated the following values are obtained:—(1) the Rhine at Coblentz above the Moselle mouth delivers per 100 sq. km. of land 1·070 cub. m. of water in a second; (2) the Weser at Minden, 0·826 cub. m.; (3) the Elbe at Torgau, 0·579; (4) the Elbe at Barby, 0·554; (5) the Oder at Steinau, 0·460; (6) the Oder below the Warta mouth, 0·413; (7) the Warta near its mouth, 0·344; (8) the Vistula at Montau Spitz, 0·538; (9) the Memel at Tilsit, 0·600.

From these numbers it appears (*a*) that the average outflow of different rivers, from equal portions of their territory, differs much more than is usually thought, for in the Middle Rhine it is about three times, in the Middle Weser two and a half times, and in the Middle Elbe, as also in the Lower Vistula and Memel, more than one and a half times as much as in the Lower Warta. On the whole, it decreases from the Rhine to the Warta, and from the latter increases again to the Memel. (*b*) In one and the same river the quantity from equal portions of land seems as a rule to decrease down stream. (*c*) All calculations of quantity of outflow in streams, based merely on extent of the region of precipitation, must as a rule give incorrect results.

It was important to try and determine the relations of the quantity of outflow to the rainfall of the corresponding regions, and Herr Graeve, doing so by a method which he describes, obtained the following percentage numbers, corresponding to the above series of rivers:—(1) = 38·5 per cent.; (2) = 37 p.c.; (3) = 30 p.c.; (4) = 28·5 p.c.; (5) = 27·2 p.c.; (6) = 21·4 p.c.; (7) = 21 p.c.; (8) = 29 p.c.; (9) = 32·5 p.c.

From this the following conclusions (briefly) are drawn:—

(*a*) The percentage proportion of the amount of outflow to the rainfall differs very considerably in these several rivers, though far less than the amount of outflow from equally large regions of these rivers; hence the differences of the latter can be due only in part to differences in the rainfall.

(*b*) The percentage decreases from the Rhine to the Warta, and increases again from the latter to the Memel. In one and the same river a decrease is perceptible down the stream, at least so far as the phenomena in the Oder and the Elbe are general.

(*c*) Since in a mountainous region a greater part of the atmospheric precipitates is carried off by rivers than in the plain, the steady decrease in the percentage proportion of outflow to rainfall in the direction from the Rhine to the Warta must be primarily attributed to the increasing flatness of the region; so too must the decrease of the percentage down stream. The influence of more or less wood on the land could not be precisely determined.

(*d*) The marked increase of the percentage in the direction from the Warta to the Memel cannot be explained by the orographic conditions of the region of precipitation, because this region in the case of the Memel is not at all hilly, and in that of the Vistula only a little more hilly than that of the Warta, but since the amount of the evaporated part of atmospheric precipitates is considerably influenced by the mean temperature of the region of precipitation, and this in the region of the Vistula and the Memel is lower than in that of the Warta, the increase of percentage in question from the Warta to the Memel must mainly be attributed to climatic conditions.

(*e*) While the percentage in question must be chiefly governed by orographic and climatic conditions, there can be no doubt that other factors also act, *e.g.*, the relative amount of moisture in the air, which influences the degree of evaporation, and in general must decrease from the rainy Rhine region to the dry region of the Warta; further, the amount of plantation, which in the regions of the Vistula and Memel is larger than in those of all other German rivers; lastly, the nature of the ground, allowing more or less passage to the precipitates; the influence of all these factors, however, cannot be proved with the same certainty as the orographic and climatic conditions.

A comparison of the amounts of outflow in different years shows that in individual rivers more important differences occur than are generally supposed, that these differences in rivers of different character and unequal force are very different in amount, and that in the same river they decrease down stream.

With regard to the difference in amount of outflow in the various seasons and months, the following average values were obtained. The amount of outflow in winter (from the beginning of November to the end of April) is to that of summer, at the parts of the stream examined, in the Rhine as 1 : 0·922, in the Weser as 1 : 0·434, in the Elbe as 1 : 0·467, in the Oder as 1 : 0·525, and further down stream as 1 : 0·522, in the Vistula as 1 : 0·486, and in the Memel as 1 : 0·389. A better idea of the regularity of the quantities of outflow is given by the relations of these for the dryest and the wettest month of the year; in the case of the Rhine this ratio is 1 : 1·458, in the Weser 1 : 4, in the Elbe 1 : 5·238, in the Oder 1 : 4·5, and further down 1 : 3·68; in the Vistula 1 : 4·19, and in the Memel 1 : 4·51.

The causes of the difference in the ratio of the largest and least monthly amounts of outflow must chiefly be sought in the presence or absence of collecting basins, as also in the orographic and climatic conditions. In the Rhine all those factors combine which affect the regularity of outflow. It possesses in the Swiss lakes large reservoirs; its river-region comprises mountains of various height, and plains, so that the

melting of the snow must occur at very different times of the year The Memel also possesses reservoirs in its marshes, and its region is perhaps better wooded than that of the other streams of Germany, but the long and hard winters cause an accumulation of large masses of ice and snow which melt suddenly and almost simultaneously in the whole region.

Herr Graeve takes up various other points, which have a practical bearing on navigation, but for these we must refer the reader to his memoir. He remarks in concluding on the desirability of comparing the conditions of outflow of German rivers with corresponding data for other European rivers, though at present the scanty and incomplete character of the data at hand render such inquiry scarcely practicable.

SCIENTIFIC SERIALS

THE *Journal of the Russian Physical and Chemical Society*, vol. xii. fascicules 5 and 6, contain, besides the minutes of meetings of the Society, the following papers :—In fascicule 5 On the dosage of chromium, by M Th. Willm.—On the composition of the hydrate of peroxide of barium, by M. E Schone —On the distribution of naphtha on the peninsula of Apsheron, by M. S Goulichambaroff —On the oxidation of ketones, by M. Goldstein —On the products of oxidation of erythrite, by M S. Przibytek —A necrology of Prof Nicolas Zinin, by MM. Borodin and Boutleroff —On the magnetisation of liquids, by M Ziloff.—On hail, by M. Schwedoff —Notes by M. Latchinoff on specific heat, on a new dynamometer, and on electrical light.—In fascicule 6 : On chlorocamphoric oxide, by M. Latchinoff —On the action of heat on phosphorites, by M Beletzky —On tetrolic acid, by M. Lagermark —On the solidification and evaporation of drops of liquid, by M Sloughinoff —On the dosage of mercury and arsenic in corpses , and an analysis of the artesian wells of Staraya Roussa.

Revue internationale des Sciences biologiques, July, 1880 — J. L. de Lanessan, on the protozoa (a chapter with illustrations from the author's forthcoming "Manuel d'Histoire Naturelle médicale) —A. Hovelacque, on the inferior races of mankind — M. Debierre, man before and on the threshold of history —Proceedings of the Academies of Paris, Belgium, and Amsterdam

August —J L. de Lanessan, the coloration and the colouring-matters in plants.—M. Moniez, on the cysticers of Tænia —M Debierre, man before and on the threshold of history —Proceedings of the Academies of Paris, Belgium, and Amsterdam.

September.—M Vulpian, physiological study of poisons : curare —M. J. L de Lanessan, the saccharomycetes and the fermentations caused by them.—Prof W. H Flower, on the comparative anatomy of man (translated from NATURE).—M R Moniez, on cestoid worms and helminthologists.—Proceedings of the Academy of Paris

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, November 18 —Prof H E Roscoe, president, in the chair.—It was announced that a ballot for the election of Fellows would take place at the next meeting (December 2) —The following papers were read .—Notes on the oxides of manganese, by Spencer Pickering Various samples of oxides were procured and heated to various temperatures, until their weight was constant , in some cases they lost weight, in others they gained, whilst in some the weight remained constant.—On aluminium alcohols, by J H. Gladstone and A Tribe When aluminium foil and iodine are heated with alcohol the latter is decomposed, two new organic aluminic compounds being formed, aluminic iodoethylate $(C_2H_5O)_6I_6Al_2$, and aluminic ethylate $Al_2(C_2H_5O)_6$ The authors have applied this reaction to other alcohols, and have thus prepared aluminic methylate, ethylate, propylate (isopropylate could not be obtained), isobutylate, amylate, cetylate, phenylate, cresylate, and thymolate. —Mr. W H. Perkin then gave an account of the artificial production of indigo by A. Baeyer, and prepared some before the Society. The steps in the process are : toluene C_7H_8O, dichloride of benzyl $C_6H_5CHCl_2$, cinnamic acid $C_9H_8O_2$, orthonitrocinnamic acid $C_9H_7(NO_2)O_2$, orthonitrodibromhydrocinnamic acid $C_9H_7Br_2O_2(NO_2)$, by the action of caustic potash orthonitrophenylpropiolic acid $C_9H_5(NO_2)O_2$ is formed, which on reduction in alkaline solution with grape sugar furnishes indigo $C_{16}H_{10}N_2O_2$.—On the synthetical production of new acids of the pyruvic series, by E. Moritz.—On the old alum well at Harrogate, by R. H. Davis. The author gives an analysis of the mineral constituents in the residue.—On the absorption spectrum of ozone, by W N Hartley —On the probable absorption of the solar rays by atmospheric ozone, by W. N. Hartley. The author has photographed and measured the absorption spectrum of ozone , he suggests that the shortening of the solar spectrum at the violet end is due to the presence of ozone in the atmosphere, also that the blue colour of the sky may be ascribed to the same cause.—On peppermint camphor, by M. Moriya of Tokiô The author has studied carefully the physical characters of this substance , he has also investigated the action of chromic acid, nitric acid, and bromine thereon

Zoological Society, November 16 —Prof Huxley, F.R S., vice-president, in the chair —Mr. W K Parker, F.R S , read a paper on the development of the skull in the Urodele Batrachians Mr. Parker described the skull of the adult Gigantic Salamander (*Sieboldia maxima*), the Siren and the Menopoma, and compared their structure with that of the various stages of the skull of the common newt.—Mr G. E Dobson, C.M Z S., exhibited and made remarks on the head of a partridge (*Perdix cinerea*) with an extraordinary prolongation of the intermaxillary bones —Mr W A. Forbes, F.Z S., made some remarks on the shedding of the horns of the Prong buck (*Antilocapra americana*), as recently observed in the specimen living in the Society's Gardens.—Mr Harting, F Z.S , exhibited a specimen of Bartram's Sandpiper, recently killed in Lincolnshire —Mr Sclater exhibited the skin of the Guinea Fowl, lately described in the Society's *Proceedings* as *Numida Ellioti*. Further investigation had induced him to believe that this bird was the same as *Numida pucherani* of Hartlaub, the inaccurate colouring of the head in Mr Elliot's figure of that species having prevented its identification —Mr G. A. Boulenger read a paper on the Palæarctic and Æthiopian species of *Bufo*, of which he recognised ten species : four in the Palæarctic, five in the Æthiopian region, and one found in both regions —A communication was read from Dr. Otto Finsch, C M Z.S., in which he gave a list of the birds of the Island of Ruk, in the Central Carolines —A second communication from Dr. Finsch contained the descriptions of some new or little-known species of pigeons from the Caroline Islands.—A communication was read from Mr. Edgar A. Smith, containing an account of the shells of the genus *Myodora* of Gray.—A communication was read from Mr Martin Jacoby, in which he gave the descriptions of a collection of Phytophagous Coleoptera made by Mr. Buckley at Eastern Ecuador. The collection contained a good many new and interesting species, of which a great part were not alone inhabitants of Ecuador, but had been found either in Peru or the Amazonian region.—A paper by Messrs F D. Godman and O. Salvin was read, in which they gave the descriptions of some supposed new species of butterflies collected by Mr Andrew Goldie in the interior of the district of Port Moresby, New Guinea.

Physical Society, November 13 —Prof W G Adams in the chair —Mr. Bosanquet, of St John's College Physical Laboratory, Cambridge, read a paper on the nature of the sounds which occur in the beats of consonance. From mistimed octaves and twelfths he found that when the beats of the harmonics are cleared away each beat consists entirely of variations in the intensity of the lower notes. He gave the mathematical theory of these beats, and likewise of the curves given by the harmonograph He also described an ear tube for using in connection with a resonator It is difficult to get definite results with a resonator unless the passage from the latter to the ear is closed to sound The ear tube consists of a copper pipe bent into a sickle shape to gird the face, so that the ends may enter the ears, into which they are screwed, plugging them close The sound is led from the resonator to the middle of the bent pipe by a flexible india-rubber tube, and thence to the ears.—Mr. Brown read a paper on action at a distance. He drew attention to the fact that though Newton disbelieved in action at a distance, he did not pronounce whether the medium was material or immaterial. Mr. Brown showed that the hypothesis of a material medium was encumbered with difficulties, since, among other reasons, direct contact could not explain gravity, projection of small particles from one body to another could not explain attraction, and Lesage's theory of corpuscles (as modified by Mr. Tolver Preston) required an enormous degree of porosity in masses of matter. The nature of magnetism and vibrations was also discussed by the author —Mr J. Macfarlane Gray read a paper on the mechanical nature of the forces called attraction, and gave grounds for attributing them to the pressures of a universal material ether of a gaseous nature The paper was long, and had to be in part left unread. The hypothesis held by Mr. Gray

is remarkably confirmed by numerical results obtained by him.—Prof. Cottrell threw some doubts on Mr. Gray's results on the score that numerical coincidences were not always safe ground for basing theoretical deductions on. Mr. Gray stated that in the parts of the paper which had to be skipped Prof. Cottrell's objections were answered. He also pointed out that Mr. Brown in his criticism of the gasiform ether had not taken into account the important condition that the particles of ether have volume.—Professors Perry and Ayrton read a note on the contact theory of Herr Exner recently brought before the Academy of Sciences of Vienna They showed that Exner's experimental results disagreed with the concordant results of several independent experimenters, namely, Kohlrausch, Hankner, and Ayrton and Perry. They concluded that Herr Exner's experiments were inaccurate. They further argued that Exner's second and later paper, so far from being a disproof of the contact theory of electromotive force as now received, is in reality a proof of it. Dr. Wright stated that he will read a paper on this subject soon; and Prof. Reinhold said that Herr Exner had since corrected some of the results of his early papers on contact electricity.—Prof Minchin of Cooper's Hill Engineering College exhibited a new photo-electric cell. This consists of a vessel of water containing a little acid, carbonate of calcium, and two tinfoil plates. When a beam of lime light was allowed to fall on one of the plates, a powerful current was set up in the cell, as seen by the deflection of a galvanometer connected in circuit with the plates. When a red glass screen intercepted the beam, the effect was very slight Prof. Minchin had begun his experiments with fluorescence, but found "hard" water containing this salt of lime do equally well. The cell possesses this advantage that the current it gives soon decreases in the light When first the light falls on it, the exposed plate is positive, but it soon changes to negative Prof. Minchin had tried the cell in place of a selenium one in the photophone, but with unsatisfactory results.

Anthropological Institute, November 9—Edward B. Tylor, D.C L, F.R.S., president, in the chair.—A paper was read on anthropological colour phenomena in Belgium and elsewhere, by J Beddoe, M.D., F.R.S. Within the last few years the numerical method had been extensively applied to the determination of ethnological colour-types, the Anthropometric Committee of the British Association having set the example. The Continental nations were, however, now far ahead of us. In Germany Prof Virchow had procured the tabulation as to the colour of the eyes and hair of all the school population, with the exception of Hamburg In Switzerland Dr. Guillaume, of Neuchâtel, had obtained school statistics. For Belgium an elaborate monograph had been written on the subject by Prof. Vander Kindere, who, by the aid of the National Geographical Society, had induced the Minister of Public Instruction to include questions on the colour of the children's eyes and hair in the educational census. The results obtained have been of considerable importance, and bring out a remarkable contrast between the Flemish and Walloon provinces of Belgium.—Mr. J. F. Rowbotham read a paper on different stages in the development of the art of music in prehistoric times. Musical instruments, though their varieties may be counted by hundreds, are yet readily reducible under three distinct types, 1. The drum type 2. The pipe type 3. The lyre type. And these three types are representative of three distinct stages of development through which prehistoric music has passed Moreover, the stages occur in the order named. That is to say, the first stage in the development of instrumental music was the drum stage, in which drums, and drums alone, were used by man. The second stage was the pipe stage, in which pipes as well as drums were used. The third stage was the lyre stage, in which stringed instruments were added to the stock. The three stages answer respectively to rhythm, melody, and harmony. And as in the geological history of the globe the chalk is never found below the oolite, nor the oolite below the coal, so in the musical history of mankind is the lyre stage never found to precede the pipe stage, nor the pipe stage to precede the drum stage.—A paper was read on neolithic implements in Russia, by Prince Paul Poutiatine. From the evidence of certain finds on his estate the author came to the conclusion: 1. That the Sclave-Scythians existed there in the stone period. 2 That they possessed instruments resembling those of the Celt-Scythians, and burned their dead. 3 That the old iron period of that neighbourhood was a continuation of the stone period. 4. That they supported themselves partly by hunting. 5. That they understood corn-growing.

Meteorological Society, November 17.—Mr. G. J. Symons, F.R.S, president, in the chair.—The following gentlemen were elected Fellows: G. Corden, E. T. Dowson, F. Hepburn, B.A., C. M. Hepworth, J. Mulvany, M.D., R N., F. H. G. Newton, Capt. M. Parry, E. P. Phillips, and H. L Roth.—The papers read were: Table of relative humidity, by Edward E. Dymond, F M S.—Rainfall in South Africa, by John G Gamble, M.A, M. Inst. C.E., F.M.S. The author gives the monthly totals of rainfall from 103 stations for the thirteen months, December 1878 to December 1879, and also the monthly means from all stations in South Africa from which a record of five years or upwards could be obtained. It is shown that the Cape Peninsula, the South-West and the West Coast, have winter rains with a dry summer, characteristics of what is called the subtropical region, the rains coming with the north-west wind or anti-trade, while Natal, Aliwal north, and in a less degree Queenstown, have the tropical features of a wet summer and dry winter. On the South Coast the rainfall appears to be more equally distributed throughout the year, though there seems to be an October maximum at Port Elizabeth and Uitenhage. In the Central and Northern Karroo the maximum of the very scanty rainfall occurs in February and March. These rains generally fall in thunderstorms; each storm seems to come from a westerly direction, but it is a more or less well-ascertained fact that these rains do not fall up country until the south-easters have set in on the South and South-West Coasts In the south-east of the colony the transition towards tropical features may be noticed, both Grahamstown and King Williamstown showing a winter minimum in June—On the meteorology of Mackay, Queensland, by Henry L Roth—Thermometrical observations on board ship, by Capt. W F. Caborne, F.M.S.

VIENNA

Imperial Academy of Sciences, November 18.—Contributions to general nerve and muscle physiology, by Dr. Biedermann—On rhythmic contractions of striped muscles, produced by chemical stimulation, by the same.—On some platino-cyanide compounds, by Herr Scholz.—On resorcin colouring matters, by Drs. Wesselskyund and Benedikt—On the formation of carboxylnatron acid from Brenz, catechin, and the constitutional formula of benzol, by Prof. v. Barth.—Note on mononitropyrogallol, by the same—The distribution of rainfall over Austria in the period August 11-15, 1880, and its relation to distribution of air-pressure, by Herr Hann.

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THURSDAY, DECEMBER 2, 1880

POLITICAL ECONOMY

Guide to the Study of Political Economy. By Dr Luigi Cossa, Professor of Political Economy in the University of Pavia. Translated from the second Italian edition. With a Preface by W. Stanley Jevons, F R S. (London: Macmillan and Co, 1880)

THE translator of Prof. Cossa's "Guide" has conferred a great boon upon the English student of political economy. The present condition of economic science generally, and especially in this country, cannot be regarded as satisfactory. The doctrines once regarded as firmly established, and the limits of discussion apparently viewed as fixed by the nature of the facts, have been subjected to criticism from the most varied grounds, and the process of disintegration, not yet completed, has not led to any general agreement with respect to the scope and principles of the science. The system of political economy, which with some justice we designate as the English, has been revised or attacked on two grounds mainly. In the first place, the fundamental notions upon which it proceeded have been criticised as too narrow and limited, as referring solely to one economic condition and as leading to results of an abstract and isolated character The "Economic Studies" of the late Mr. Bagehot represent fairly this phase of opinion, while the excellent little compendium by Prof. and Mrs Marshall, the "Economics of Industry," is a specimen of the mode in which the older theorems require to be restated in the light of more general principles. In the second place, the great advance in what we may call social science, and the application of the historic method to the study of the various orders of social facts, have led, on the part of many modern writers, to an almost total rejection of the whole system of doctrines grouped together under the title of Political Economy The fundamental principles, the methods of reasoning from them, and the conclusions arrived at, have all been questioned, while a perfectly chaotic state of opinion appears to exist regarding the nature and method of that which is to take the place of the formerly accepted doctrine.

The present work supplies most timely aid in the discussion of these complicated problems. The first part (pp 1–84), which treats in a thoughtful and judicious manner the province of political economy, its method, and its bearing upon social facts generally, brings into due prominence the immense extent and variety of the inquiries which, in an unsystematic fashion, have come to be included in one body of doctrine, and fairly warrants the conclusion that in future we must regard political economy as a complex of different sciences, with distinct aims and requiring distinct methods of treatment. The second part (pp 85-227), containing a brief sketch of the history of the science, which we may without hesitation pronounce as unrivalled of its kind, leads by another path to the same result. The English student will learn from this history of the development of the science, more especially from the admirable account of recent German and Italian works, the nature of the various general principles which have been accepted as furnishing the foundation of economics and its allied branches, and will be enabled to discover in what respects mainly the peculiar doctrines of the older system require revision and amendment.

Prof. Cossa would doubtless be the first to admit that the brief treatment here given of so complex a problem as the determination of the province and logical character of political economy cannot be expected to furnish a final solution. His remarks on the essential nature of pure or theoretical political economy, which he regards as the science of the *social* laws of wealth, are at least instructive and helpful, while the sections on the relation of economics to the various branches of legislative science leave little to be desired At the same time it may be doubted whether there is really any place for the art of political economy here alluded to, and it may be questioned whether the mode the author adopts for separating economics from technology on the one hand, and from economic legislation on the other, is satisfactory in itself, or so clear as what we find, *e g*, in Hermann and Wagner The chapter on Method in Political Economy contains little more than a judicious reproduction of Cairnes' well-known essay, and the remarks on the historical method, though acute and sensible, do not seem to us to go to the root of the matter

The historical sketch, the main feature of the work, deserves every praise that can be given for breadth and exactitude of knowledge, for fairness and acuteness of criticism Particularly valuable are the sections on the Political Economy of the Greeks and Romans, and on the Physiocratic school. One recognises with satisfaction the cordial appreciation extended by the author to certain great works of modern Continental economists which are scarcely known, even by name, in this country, but which must be pronounced absolutely indispensable to the student. Such *e g*. are v. Hermann's "Staatswirthschaftliche Untersuchungen," the first section of which is certainly the best treatment of the fundamental notions of pure economics, v. Mangoldt's "Volkswirthschaftslehre," Knies' "Geld und Credit," Courcelle-Seneuil's "Traité," and Cherbuliez' "Précis." As text-books of the subject, v Mangoldt's "Grundriss" and Cherbuliez' "Précis" are unsurpassed.

Naturally one cannot always assent to the critical opinions expressed on detached doctrines or authors. Thus it seems to us that the author ought not to have included Codillac without further mention as a follower of Quesnay; that his estimate of the merits of Storch's "Cours" is much too low, that he is hardly fair to von Thunen's acute speculations on interest and wages, and that he is quite mistaken regarding the nature of v Mangoldt's theory of profit What Prof. Cossa, in this connection, stigmatises as "an equivocation" (p. 200) is in fact a misunderstanding of his own

In a brief sketch covering so wide a literature as that of political economy, absolute completeness is not to be expected, and probably the author has good reasons for omitting various names which occur to one as having a place in the history of the science. Still one is surprised to find a studious omission of the whole school of economical writers to which the vague term *socialist* has been applied. Proudhon, we think, is mentioned once; Fourier, St. Simon, and Karl Marx are not mentioned at all. So

too, American writers are dismissed without notice, save a passing allusion to F A. Walker. Carey's theories are occasionally referred to in connection with other names, but no specific account is given of them, nor are other American authors, orthodox or heterodox, better treated. Even a general history ought not, one would think, to have omitted notice of such writers as Lord Lauderdale (whose treatment of Demand and of the Functions of Capital has not received the attention it deserves), R. Jones (whose essay on the Early English Economists might also have been noted in its proper place), Jacob, Stirling (the translator of Bastiat and author of an excellent but well-nigh forgotten work, "Philosophy of Commerce"), Bernhardi (the author of a remarkable treatise on Large and Small Landed Properties), Hubner, H. Thornton, Baumstark, Skarbek, Cieskowski, Saint-Chamans, Esmenard de Mazet, Louis Say, Schon, Canard, and Cazeaux. Dureau de la Malle's work might have been noted in connection with the political economy of the Romans, and De Tracy's name should not have passed without reference to his commentary on Montesquieu.

The translation appears to us generally excellent, and the translator, who is evidently well acquainted with the subject, deserves much credit for the clear and concise English into which she has rendered Prof. Cossa's work

OUR BOOK SHELF

Avis préliminaire d'une nouvelle Classification de la Famille des Dytiscidæ Par D Sharp. (Extrait des *Comptes rendus* de la Société Entomologique de Belgique, Séance du 4 septembre, 1880)

DR. SHARP is well known to have been long occupied on a work on the water-beetles of the world (at any rate on those of this particular family) The author announces it as ready for the press, and has forwarded to the Belgian Entomological Society a sketch of his ideas of the limits of the family and its classification, from which we learn that about 80 genera are recognised One of the most important characters, as separating true *Dytiscidæ* from *Carabidæ* and from all other *Coleoptera*, appears to consist of the condition of the metathoracic episternum in connection with the intermediate cotyloid cavities The family as a whole is divided into two great divisions, termed "*fragmentati*" and "*complicati*," the latter being headed by the anomalous genus *Amphizoa*, the position assigned to which will perhaps not find universal favour No one can doubt that the book, when it appears, will mark an era in this department of entomology It is a great pity therefore that Dr Sharp should throw himself open to the shafts of ridicule in his choice of terms wherewith to designate some of his new genera We need only allude here to such terms as *Huxelhydrus* (presumably a misprint for *Huxleyhydrus*), *Darwinhydrus*, and *Tyndallhydrus* ! ! ! We all honour the names that form the prefixes, and fail to realise the watery connection suggested.

Aid to the Identification of Insects Edited by Charles Owen Waterhouse Lithographs by Edwin Wilson. Small 4to, Part I. (London. E W. Janson, 35, Little Russell Street, W.C.)

MR. WATERHOUSE, whose duties in the zoological department of the British Museum have probably continually caused him to feel the want of some such work as that which he now commences under the above title, has conceived the idea of issuing, at intervals of a month or six weeks, a series of hand-coloured drawings of insects of all orders not previously figured. Every working naturalist knows that a good pictorial representation conveys a more accurate and ready perception of a species than the most elaborate verbal description; and we can imagine no more ready way of widely disseminating a knowledge of the arcana of science than this. Each part is to contain eight or nine plates, each representing a single species, with its generic and specific names, the name of its describer, and a reference to its locality and place of description The plates can be classified on the completion of a volume (twelve parts), when a title-page and index will be issued.

The first part, just issued, contains some well-executed figures of *Coleoptera*, *Hemiptera*, and *Lepidoptera*. The whole idea is unconsciously a repetition of Prof. McCoy's "Prodromus of the Zoology of Victoria," but with no Government money to back it up.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]

The Editor urgently requests correspondents to keep their letters as short as possible The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Geological Climates

I HAVE read with much interest Mr Starkie Gardner's letter in NATURE, vol. xxiii p 53.

It is not necessary for me to discuss the question whether I am right in requiring an increase of 20° F. mean annual temperature at Bournemouth in Eocene times, or whether he is right in demanding an increase of only 14° F to 15°, for I am able to show that the one increase is as *impossible* as the other, on the principles held by Lyell and his followers.

Mr Starkie Gardner's ideas on the subject of oceanic circulation and its effects upon climate are expressed in the following words.—

"The general cooling effect of incessant oceanic circulation between the North Pole and the Tropics is, I think, scarcely taken into sufficient account, and although it may be contended that conversely the northerly flow of the Gulf Stream mitigates climate, I think that its action in Europe is chiefly in fending off the ice-laden currents from our coasts," &c, &c.

This statement, to my mind, involves so complete a misapprehension not only of the physical causes of oceanic circulation, but also of the whole problem of geological climate, that I shall ask your permission to lay down a few elementary propositions on the subject, which are capable of demonstration

1 The Gulf Stream of the North Atlantic, so far from acting the part of a policeman in "fending off" imaginary cold water streams from the Polar regions, is the *cause of their existence.* If there were no Gulf Stream there could be no Labrador current of cold water running south The same statement is true of the Kuro Siwo of the North Pacific, of the Brazilian current of the South Atlantic, and of the Mozambique curren of the Indian Ocean.

2 If the globe were covered with water, or in the condition of an archipelago pretty uniformly distributed, there would be no exchange of currents between the Tropics and the Poles, and consequently no effect upon climate Within the Tropics there would be a broad, slow current of warm water moving from east to west, and producing no effect upon climate. In the temperate zones there would be in the northern hemisphere a feeble interchange of south-westerly and north-easterly currents, and in the southern hemisphere a similar interchange of north-westerly and south-easterly currents, both incapable of affecting climate to any sensible degree.

3. If a north and south barrier be constructed to the westward of a locality like the West of Europe; such a barrier as North and South America affords, a gulf stream is, at once, formed, and a corresponding Labrador current running in the opposite direction.[1] The effect of the Gulf Stream is to raise the temperature of the West of Europe to its *maximum*, and the effect of the Labrador current is to depress the temperature of the east coast of North America to its *minimum*.

4. It is *impossible* to suggest any rearrangement of land and water which shall sensibly *raise the temperature of the West of*

[1] The earth's rotation compels the Gulf Stream to impinge on the west coast of Europe, and the Polar current on the east coast of North America.

Europe, or sensibly *depress the temperature of the east of North America.*

Mr. Gardner makes the following hypothetical redistribution of land and water :—

"Supposing, as all evidence tends to prove,[1] that Northern Europe and America were connected by continuous land in Eocene time, would not the mere fact of shutting off the Arctic seas cause a general and perhaps sufficient rise of temperature ?"

My answer to this is that such an arrangement of land and water in the North Atlantic would raise considerably the present *minimum* temperature of the east coast of North America, but would produce little or no effect in raising the already *maximum* temperature of West Europe, which already receives the full benefit of the Gulf Stream, and suffers none of the injuries of the Labrador current.

It seems to me not possible to raise the mean annual temperature of Bournemouth 15° F. or 20° F. without supposing an *increased Gulf Stream*, in other words, an *an increased sun-heat*, which is contrary to the ideas of Lyell and his followers.

I must again ask Mr. Duncan to name the *species* of bamboo that flourishes so luxuriantly at Cooper's Hill under the disadvantageous conditions he has so well described.

If he decline to do so I have no other remedy than to go to the Indian Engineering College on my next visit to London, and inspect and report on the bamboo myself.

Trin. Coll. Dub., November 23 SAML. HAUGHTON

[1] I entirely deny this, but will not now turn aside from my present purpose to discuss it.

"Sulphuric Acid and Alkali"

MR. MACTEAR informs me that the statements contained in my review of Prof. Lunge's second volume, which appeared in your columns last week, require amendment, and I beg, in justice to Mr. Mactear, to make the following remarks :—

1. It appears that the direct object of Mr. Mactear's process is to reduce the amount of limestone to the least possible amount. Hence the words "in excess of that usually worked" are to be omitted in the sentence referring to this subject.

2. With regard to the statement that many thousands of pounds have been gained in a single works by the adoption of Mr. Mactear's process, that gentleman has placed in my hands the proof that this fact is correct.

There remains however no doubt that, in the Lancashire district at least, the liming process is not now so generally adopted as Dr. Lunge implies; but this may be explained by the fact that Mactear's process greatly reduces the quantity of caustic soda, and this does not suit the Lancashire plan of working. H. E. ROSCOE

A General Theorem in Kinematics

PROF. MINCHIN has been anticipated in his discovery of the theorem on uniplanar motion given in NATURE, vol. xxiii. p. 62. It was published some six years ago by Prof. W. Schell of the Polytechnikum, Carlsruhe, in the *Zeitschrift fur Mathematik und Physik*, xix. 3. The paper containing it is entitled "Ueber den Beschleunigungzustand des ebenen unveranderlichen, in der Ebene beweglichen Systems," and commences at p. 185. The two parts of the theorem will be found in leaded type at pp. 190 and 192. The paper (which is an admirable specimen of clear writing) is purely kinematical, and treats only of motion *in plano*. The dynamical consequences pointed out by Prof. Minchin are accordingly not to be found in it, nor the analogous theorem for the general motion of a rigid body obtained by Prof. Wolstenholme. The following quaternion proof of the latter theorem may interest some of your readers.

The velocity ρ of the particle at vector distance ρ from a fixed origin is—

$$\dot{\rho} = \alpha + V\beta\rho,$$

α being the velocity at the origin, and β the angular velocity.

The acceleration is therefore—

$$\ddot{\rho} = \dot{\alpha} + V\dot{\beta}\rho + V\beta(\alpha + V\beta\rho),$$

and will be zero for one definite value of ρ.

Taking the point of no acceleration for origin, the constant terms in the expression for the acceleration must vanish, and the expression will be reduced to—

$$\ddot{\rho} = V\dot{\beta}\rho + V\beta V\beta\rho,$$

which is identical with Prof. Wolstenholme's result.

Malone Road, Belfast, November 22 J. D. EVERETT

Phosphorescent Centipedes

ON September 28 last I was walking in my garden here at eight o'clock in the evening with a friend, when we were simultaneously attracted by a bright light about twenty paces in front of us. The light was so bright that in the distance it looked like moonlight through the trees; and had the moon been shining we should probably not again have thought about the light until we came upon it. But it was a dark night, though warm and even sultry, and still. The light was so bright that, taking a letter out of my pocket, I could read it. It resembled an electric light, and proceeded from the bodies of two centipedes and their two trails. The centipedes were about four inches apart. The light illumined the entire body of the animal, and seemed to increase its diameter three times. It flashed along both sides of the creature in sections, there being about six sections from head to tail, between which the light played. The light behaved precisely like the electric light, moving as it were perpetually in two streams, one on each side, and yet lighting up the whole body. In the trail there was no movement, but light only. The trail extended 1½ foot from each centipede over the grass and the gravel-walk, and it had the appearance of illuminated mucus.

Having observed these creatures for several minutes, I picked one of them up and lodged it in a box which had been procured from the house, for further observation. On touching the centipede the light in both animals, as well as in both trails, was instantly extinguished. Later in the evening we found another centipede, and this also emitted light in the same manner, both from body and trail as I have described. My gardener then informed me that he had observed these creatures during the previous three or four evenings, both in the garden and in the stableyard.

On the following day I took the centipede to Prof. Flower, who, with the assistance of the authorities of the British Museum, has identified the species as *Geophilus subterraneus*.

The published descriptions of the luminous properties of the British centipedes differ considerably from what I observed in this instance.

The best, so far as I know, is given in Shaw's "General Zoology," vol. vi. After describing the animal, it proceeds thus. "It is possessed of a high degree of phosphoric splendour, which, however, seems to be only excited when the animal is pressed or suddenly disturbed, when it diffuses a beautiful smaragdine light, so powerful as not to be obliterated by the light of two candles on the same table."

I may observe that I was never able to induce my centipede to shine whilst in captivity. It may also be worthy of note that the atmosphere was exceptionally dry and the barometer remarkably high at the time of the observation.

B. E. BRODHURST

Grange Court, Chigwell, November 22

The Yang-tse, the Yellow River, and the Pei-ho.

ALTHOUGH the conclusions at which Dr. Woeikof has arrived (NATURE, vol. xxiii. p. 9) with regard to my estimations of the discharge of water and sediment of the Yang-tse and Pei-ho may militate against their being accepted as generally typical of these two rivers, I would urge that another series of observations would be of more service in either correcting or in corroborating my estimations.

In the case of the Yang-tse it will have been seen that, according to the estimate of Capt. Blakiston at I-chang and of my own at Hankow—500,000 and 650,000 cubic feet of water per second respectively,—this river increases its discharge by 150,000 cubic feet in the 360 miles that intervene between these two places of observation. In this portion of its course the Yang-tse not only receives the waters of the Han, but is also the recipient of those of the Tung-ting Lake, and the increase it receives from these two important tributaries—an amount exceeding the water-discharge of the Nile[1]—is not such as would support the conclusion that my estimate for the Yang-tse at Hankow is under the usual average.

My observations on the Pei-ho, referring as they do to only a portion of the year, are more open to correction, and a series of observations throughout the entire twelve months are certainly to be preferred.

In conclusion I may state that, although my various estimations are open to criticism, my object will have been gained if, by inviting further inquiry into the hydrological features of the great river system of China, an accurate knowledge of them is obtained. H. B. GUPPY

[1] 130,000 cubic feet per second.

Aurora observed at Ovoca, Co. Wicklow, November 3.—Observations from 5 30 p.m. to Midnight

AT 5.30 p.m. yellow lights tinged with red were coming up all round the horizon; these at intervals formed indistinct columns to the south-west and north west At 6.30 there were faint reddish lights forming fans at different points, these were succeeded by red and orange lights that rose forming glows, columns, and pencils, while at 7 30 a bright silver-white arch appeared to the north—the horns from this arch were pencils of white, which seemed to cross the arch, they were very numerous, appearing and disappearing nearly instantaneously, from about four to seven appeared at one time. Some of them were very long, shooting up to the zenith. After the arch had dissolved away, brilliant narrow, well-defined, thin columns of silver light shot up, the most marked coming up to the north-west at 7 40, this darted up suddenly, and moved gradually southward, and when about due west, close to the church tower, it disappeared at 7 45

These silver lights solely occurred between the west and north-east, while all round the horizon red and orange lights were rising; these sometimes congregated at the zenith in a mass. At 7.50 two brilliant silver pencils rose to the north-north-east, but disappeared nearly instantaneously.

From 8 p m to 8 50 there were orange and red glows of light sometimes in indistinct columns; but at the latter hour there appeared to the north west a vivid display of silver light that lasted about five minutes, this was succeeded by a deep orange cloud that travelled up to the zenith From 9 to 10 30 there was an orange to red glow round the horizon, while at intervals from the north-west rose pencils of silver light, five very brilliant ones rising at 10.30 They were succeeded by a bright silver glow over the whole of the western heaven, across which at intervals passed glows of red and orange light; columns also rose, while at times horizontal streaks of brilliant silver lights appeared and disappeared in a flash At 11 there was an orange glow round the horizon, this, with spurts of light coming up between the south west and north-east, were all that was observed up to midnight.

G H KINAHAN

MR. SPENCER AND PROF. TAIT

WHEN, in NATURE for July 17th, 1879, while reviewing Sir Edmund Beckett's book, Prof. Tait lugged in Mr. Kirkman's travesty of the definition of Evolution, most readers probably failed to see why he made this not very relevant quotation But those who remembered a controversy which occurred some years previously, possibly divined the feeling which prompted him thus to go out of his way

At the time I said nothing, but having recently had to prepare a new edition of "First Principles," and thinking it well to take some notice of books, and parts of books, that have been written in refutation of that work, I decided to deal also with Mr. Kirkman's implied criticism, in which Prof. Tait so heartily concurred, and by way of gauging Prof Tait's judgment on this matter, I thought it not amiss to give some samples of his judgment on matters falling within his own department To make it accessible to those possessing previous editions of "First Principles," the Appendix containing these replies to critics was published as a pamphlet

In the inaugural lecture of this session, recently given to his students, part of which is published in the last number of NATURE, Prof. Tait first of all recalls a passage from the preceding controversy. From this he quotes, or rather describes, a clause which, standing by itself, appears sufficiently absurd; and he marks the absurdity by a double note of admiration. Whether when taken with its context it is absurd, the reader will be able to judge on reading the passage to which it belongs

In disproof of certain conclusions of mine, there had been quoted against me the *dictum* of Prof. Tait concerning the laws of motion, which is that—"as the properties of matter might have been such as to render a totally different set of laws axiomatic, these laws must be considered as resting on convictions drawn from observation and experiment and not on intuitive perception." Not urging minor objections to this *dictum*, I went on to say:—"It will suffice if I examine the nature of this proposition that 'the properties of matter *might have been*' other than they are Does it express an experimentally-ascertained truth? If so, I invite Prof. Tait to describe the experiments? Is it an intuition? If so, then along with doubt of an intuitive belief concerning things *as they are*, there goes confidence in an intuitive belief concerning things *as they are not*. Is it an hypothesis? If so, the implication is that a cognition of which the negation is inconceivable (for an axiom is such) may be discredited by inference from that which is not a cognition at all, but simply a supposition . I shall take it as unquestionable that nothing concluded can have a warrant higher than that from which it is concluded, though it may have a lower Now the elements of the proposition before us are these —*As* 'the properties of matter might have been such as to render a totally different set of laws axiomatic' [*therefore*] 'these laws [now in force] must be considered as resting . . . not on intuitive perception ' that is, the intuitions in which these laws are recognised, must not be held authoritative. Here the cognition posited as premiss, is that the properties of matter might have been other than they are, and the conclusion is that our intuitions relative to existing properties are uncertain Hence, if this conclusion is valid, it is valid because the cognition or intuition respecting what might have been, is more trustworthy than the cognition or intuition respecting what is!"

From which it is manifest that, when asking (of course ironically) whether this alleged truth was an experimentally-ascertained one, my purpose was partly to ennumerate and test all imaginable suppositions respecting the nature of Prof Tait's proposition, and partly to show that he had affirmed something concerning the properties of matter which cannot be experimentally verified, and therefore which, by his own showing, he has no right to affirm

The first example which, in my recent replies to criticisms, I have given of Prof Tait's way of thinking, is disclosed by a comparison of his views concerning our knowledge of the universe as visible to us, and our knowledge of an alleged invisible universe This comparison shows that —

"He thinks that while no validity can be claimed for our judgments respecting perceived forces, save as experimentally justified, some validity can be claimed for our judgments respecting unperceived forces, where no experimental justification is possible"

Part of Prof. Tait's answer is that "the theory there developed [in the "Unseen Universe"] was not put forward as probable, its purpose was attained when it was shown to be conceivable." To which I rejoin that whereas Prof Tait said he found in this theory a support for certain theological beliefs, he now confesses that he found none, for if no probability is alleged, no support can be derived. The other part of his answer concerns the main issue. After pointing out that the argument of this work, "carried on in pursuance of physical laws established by converse with the universe we know, extends them to the universe we do not know," I had urged that if we have "no warrant for asserting a physical axiom save as a generalisation of results of experiments—if, consequently, where no observation or experiment is possible, reasoning after physical methods can have no place; then there can be no basis for any conclusion respecting the physical relations of the seen and the unseen universes," "since, by the definition of it, one term of the relation is absent." Prof. Tait's explanation is extremely startling When following the discussion in the "Unseen Universe," throughout which the law of the Conservation of Energy and the Principle of Continuity are extended from the tangible and visible matter and motion around us to an

unknown form of existence with which they are supposed to be connected, readers little thought that Prof Tait meant by this unknown form of existence his own mind. Yet this is all that he now names as the missing term of the relation between the seen universe and the unseen universe.

The second sample which I gave of Prof Tait's views on matters pertaining to his own subject, concerned the nature of inertia, which he describes by implication as a positive force Here I quoted Prof. Clerk Maxwell. To repeat his criticism in full would cause me to trespass on the pages of NATURE even more unduly than I must do. If, however, any reader turns to NATURE, July 3rd, 1879, and reads the passage in question, he will be able to judge whether it is, or is not, a joke, and if a joke, at whose expense. Meanwhile, the essential question remains. Prof. Tait says that matter has "an innate power of resisting external influences." I, contrariwise, say that the assertion of such a power is at variance with established physical principles.

One further illustration of Prof. Tait's way of thinking was added. Quoting from a lecture given by him at Glasgow, for the purpose of dispelling "the widespread ignorance as to some of the most important elementary principles of physics," I compared two different definitions of force it contained. In a passage from Newton, emphatically approved by Prof Tait, force is implied to be that which changes the state of a body, or, in modern language, does work upon it Later on in the lecture, Prof. Tait says—"force is the rate at which an agent does work per unit of length." I contended that these definitions are irreconcilable with one another, and I do not see that Prof. Tait has done anything to reconcile them True, he has given us some mathematics, by which he considers the reconciliation to be effected, and, possibly, some readers, awed by his equations, and forgetting that in symbolic operations, carried on no matter how rigourously, the worth of what comes out depends wholly on what is put in, will suppose that Prof. Tait must be right. If, however, his mathematics prove that while force is an agent which does work, it is also the rate at which an agent does work, then I say—so much the worse for his mathematics

From these several tests of Prof. Tait's judgment, in respect to which I fail to see that he has disposed of my allegations, I pass now to his implied judgment on the formula, or definition, of Evolution And here I have first to ask him some questions. He says that because he has used the word "definition" instead of "formula," he has incurred my "sore displeasure and grave censure." In what place have I expressed or implied displeasure or censure in relation to this substitution of terms? Alleging that I have an obvious motive for calling it a "formula," he says I am "indignant at its being called a *definition*." I wish to see the words in which I have expressed my indignation; and shall be glad if Prof Tait will quote them. He says—"It seems I should have called him the *discoverer of the formula!*" instead of "the inventor of the definition." Will he oblige me by pointing out where I have used either the one phrase or the other? These assertions of Prof. Tait are to me utterly incomprehensible I have nowhere either said or implied any of the things which he here specifies. So far am I from consciously preferring one of these words to the other, that, until I read this passage in Prof. Tait's lecture, I did not even know that I was in the habit of saying "formula" rather than "definition." The whole of these statements are fictions, pure and absolute.

My intentional use of the one word rather than the other, is alleged by him *à propos* of an incidental comparison I have made. To a critic who had said that the formula or definition of Evolution "seems at best rather the blank form for a universe than anything corresponding to the actual world about us," I had replied that it might similarly be "remarked that the formula—'bodies attract one another directly as their masses and inversely as the squares of their distances,' was at best but a blank form for solar systems and sidereal clusters." Whereupon Prof. Tait assumes that I put the "Formula of Evolution alongside of the Law of Gravitation," in respect to the definiteness of the previsions they severally enable us to make; and he proceeds to twit me with inability to predict what will be the condition of Europe four years hence, as astronomers "predict the positions of known celestial bodies four years beforehand." Here we have another example of Prof. Tait's peculiarity of thought. Because two abstract generalisations are compared as both being utterly unlike the groups of concrete facts interpreted by them, *therefore* they are compared in respect to their other characters.

But now I am not unwilling to deal with the contrast Prof Tait draws, and am prepared to show that when the conditions are analogous, the contrast disappears. It seems strange that I should have to point out to a scientific man in his position, that an alleged law may be perfectly true, and that yet, where the elements of a problem to be dealt with under it are numerous, no specific deduction can be drawn Does not Prof Tait from time to time teach his students that in proportion as the number of factors concerned in the production of any phenomenon becomes great, and also in proportion as those factors admit of less exact measurement, any prediction made concerning the phenomenon becomes less definite, and that where the factors are multitudinous and not measurable, nothing but some general result can be foreseen, and often not even that? Prof. Tait ignores the fact that the positions of planets and satellites admit of definite prevision, only because the forces which appreciably affect them are few, and he ignores the fact that where further such forces, not easily measured, come into play, the previsions are imperfect and often wholly wrong, as in the case of comets; and he ignores the fact that where the number of bodies affecting one another by mutual gravitation is great, no definite prevision of their positions is possible. If Prof. Tait were living in one of the globular star-clusters, does he think that after observations duly taken, calculations based on the law of gravitation would enable him to predict the positions of the component stars four years hence? By an intelligence immeasurably transcending the human, with a mathematics to match, such prevision would doubtless be possible, but considered from the human standpoint, the law of gravitation, even when uncomplicated by other laws, can yield under such conditions only general and not special results. And if Prof. Tait will deign to look into "First Principles," which he apparently prides himself on not having done, he will there find a sufficient number of illustrations showing that not only other orders of changes, but even social changes, are predictable in respect to their general, if not in respect to their special, characters

There remains only to notice the opinion which Prof Tait seems still to hold, that the verbal transformation which Mr Kirkman has made in the formula or definition of Evolution, suffices to show its hollowness. Here I may be excused for repeating what I have already said elsewhere, namely, that "We may conveniently observe the nature of Mr. Kirkman's belief, by listening to an imaginary addition to that address before the Literary and Philosophical Society of Liverpool, in which he first set forth the leading ideas of his volume, and we may fitly, in this imaginary addition, adopt the manner in which he delights

"Observe, gentlemen," we may suppose him saying, "I have here the yolk of an egg The evolutionists, using their jargon, say that one of its characters is 'homogeneity'; and if you do not examine your thoughts, perhaps you may think that the word conveys some idea. But now if I translate it into plain English, and say that

one of the characters of this yolk is 'all-alikeness,' you at once perceive how nonsensical is their statement. You see that the substance of the yolk is not all-alike, and that therefore all-alikeness cannot be one of its attributes Similarly with the other pretentious term 'heterogeneity,' which, according to them, describes the state things are brought to by what they call evolution It is mere empty sound, as is manifest if I do but transform it, as I did the other, and say instead 'not-all-alikeness' For on showing you this chick into which the yolk of the egg turns, you will see that 'not-all-alikeness' is a character which cannot be claimed for it. How can any one say that the parts of the chick are not-all-alike? Again, in their blatant language we are told that evolution is carried on by continuous 'differentiations'; and they would have us believe that this word expresses some fact. But if we put instead of it 'somethingelseifications' the delusion they try to practise on us becomes clear How can they say that while the parts have been forming themselves the heart has been becoming something else than the stomach, and the leg something else than the wing, and the head something else than the tail? The like manifestly happens when for 'integrations' we read 'sticktogetherations' what sense the term might seem to have, becomes obvious nonsense when the substituted word is used For nobody dares assert that the parts of the chick stick together any more than do the parts of the yolk I need hardly show you that now when I take a portion of the yolk between my fingers and pull, and now when I take any part of the chick, as the leg, and pull, the first resists just as much as the last—the last does not stick together any more than the first, so that there has been no progress in 'sticktogetherations.' And thus, gentlemen, you perceive that these big words which, to the disgrace of the Royal Society, appear even in papers published by it, are mere empty bladders which these would-be philosophers use to buoy up their ridiculous doctrines"

But though it is here, I think, made apparent enough that even when disguised in Mr Kirkman's grotesque words, the definition of Evolution continues truly to express the facts, Prof Tait shows no sign of changing his original opinion that Mr Kirkman has made "an exquisite translation" of the definition Nay, so charmed does he appear to be with Mr Kirkman's feats of this nature, that he gives us another of them One of two conclusions must be drawn. Prof Tait either thinks that fallacies are disclosed by the aid of these cacophonous long words, or else the clatter of curious syllabic compounds greatly excites his sense of humour In the last case we may infer that had he been one of that "Twelfth Night" party in which the Clown exclaims—"I did impeticos thy gratillity," he would have joined in Sir Andrew Aguecheek's applause HERBERT SPENCER

NOTES ON THE GEOLOGY OF EAST-CENTRAL AFRICA

THOUGH many travellers have now penetrated almost every part of Central Africa, and described the main geographical features, yet their accounts have been singularly barren in any reliable geological details. The Geographical Society, in its late expedition to the lake region, sought to remedy this want, and I, as a student of that science, had the honour of being selected as geologist and assistant to Mr. Keith Johnston, the leader of the expedition.

After the lamentable death of Mr. Johnston, almost at the commencement of our journey, the entire work of the expedition fell into my inexperienced hands, and to perform that work conscientiously precluded all hope of anything but the most superficial geological research. The difficulties in the way were, as in all tropical countries, much increased by the luxuriance of the vegetation, which seldom leaves a rock uncovered and exposed to view. Notwithstanding these obstacles to geological investigation, however, glimpses of the internal structure of the country traversed were here and there obtained, which I think may fairly be considered as shadowing forth the main general features of the geology of the Great Lake Region

Let me briefly point these out in the order of their occurrence along our route to Nyassa and Tanganyika. The comparatively unbroken stretch of low-lying country which so markedly borders the East Coast of Africa is formed of two, if not three, raised beaches, elevated in recent times above the sea. They consist chiefly of brick-red sands and clays overlying coral rock. The former have been derived by denudation from the coast ranges, which, consisting of hornblende rocks and others containing a large amount of iron, easily account for the deep-red colour characterising these deposits. The sands are of value as containing the gum copal, of which our best varnishes are made As the tree from which this gum has been derived is now almost extinct, it would seem that a considerable lapse of time has occurred since these deposits have been formed; but geologically they must be recent, as among the many insects that have been found imbedded in the copal none, as far as I am aware, are extinct The Msandarusi, or gum copal tree, has evidently been restricted to the sea-coast, as neither it nor the gum has ever been found as yet in the interior.

In passing from these sands and clays we step over an immense gap in the geological record, of which no trace remains, as the rocks we next reach are evidently of carboniferous age These occupy a variable strip along the base of the mountains, here and there rising into small hills and ranges

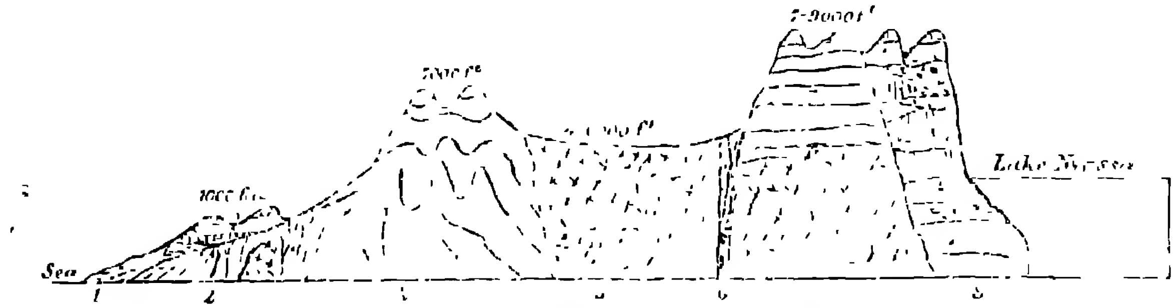
They are found stretching from at least Mozambique to the Equator. On the Rovuma coal-beds are found In the Rufigi valley there are red liver-coloured sandstones with pebbled beds and with interbedded lavas which in one curiously-shaped mountain near Behobeho produce a remarkable step-like appearance. These beds are horizontal, but beneath them are sandstones tilted by the intrusion of eruptive basalts, producing an unconformability which however is probably only local. Further north on the Unyanyembe road from Bogamoyo, and at the base of the mountain I observed on my return march compact beds of fossiliferous limestones, together with shales, &c.

At Umba, a place north of Pangani, I also discovered limestone, which I believe is now being burnt by the Universities Mission Agents. The young geologist, Thornton, the companion of Baron von der Decken, observed this same formation around Mombas, which he noted as being exactly similar to the coal formation of the Zambesi. As no rocks of a later date have been found along the whole of the east coast from Mozambique to the Equator, we may safely infer that this part of the continent has been above water since Carboniferous times, and this inference is strengthened by natural history evidence.

We have now reached the base of the mountains, and again we are brought face to face with another great break in the series of events. From the Carboniferous sandstones and limestones we pass abruptly to highly metamorphosed rocks whose exact place in the geological series is as yet extremely problematical. These consist of the schists, gneiss, and hornblende rocks which form the mountain range that flanks the great Central Plateau extending from Abyssinia to the Cape.

In crossing this range we rose to a height of 7000 feet. We found the strike of the rocks to be north and south They present every intermediate grade of variation from the most coarsely crystalline to those with the bedding still traceable. Indeed it would be somewhat difficult to point out any sharply-defined line of demarcation between the granites, which seem to predominate

in the plateau, and the less metamorphosed rocks It seems to me that this range suggests a line of weakness during the elevation of the continent, owing to which the neighbouring rocks were more easily folded up and raised above the line of greatest pressure, which has turned the main mass of the continent into granite There is however some hope that more definite light will be thrown upon the question of the age of this range, as on my way back to the coast I discovered in the Usagara Mountains some much metamorphosed rocks with imperfectly pre-

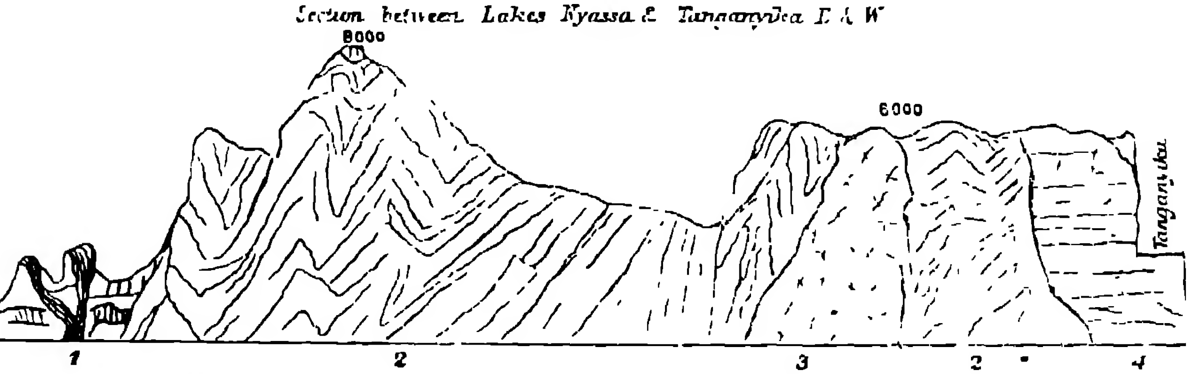


Section of Rocks between Dar-es-salaam and Lake Nyassa 1, Red sandy clays 2, Carboniferous (?) sandstones with intrusive rocks 3 Carboniferous sandstones with interbedded lavas, 4, Schists, gneiss, and other highly metamorphosed rocks, 5 Granite forming main mass of the interior, 6, Intrusive rocks and probable line of fault, 7, Clay slates with occasional felspathic rocks, 8, Volcanic porphyrites, tuffs, and agglomerates

served fossils. A careful search would probably be rewarded by the discovery of fossils which would determine the age of these rocks.

Leaving the metamorphic rocks of the flanking range, we next pass over a great stretch of granitoid rocks This tract, extending to near the lakes, is marked by undulating hills and valleys, with wide areas comparatively level, where the Kaffir-like semi-nomadic tribes of the Wabena, Warori, Wahehi, Wagogo, and Masai herd their cattle, hunt, and live in a constant state of warfare.

Section between Lakes Nyassa & Tanganyika E & W

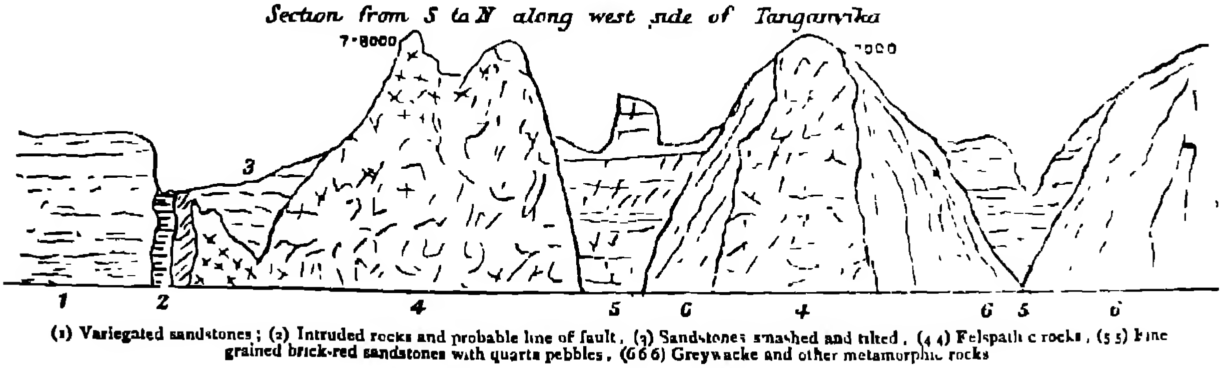


1, Volcanic porphyrites and tuffs, 2 2, Clay slates, schists, and gneiss, 3, Intrusive granite, 4, Variegated sandstones slightly metamorphosed

The influence which the character of the country has upon the habits and manners of savage tribes is here well illustrated.

The soil formed by the degradation of this granite tract is either a stiff red clay as occurs in Ubena and Urori, sandy as in Ugogo, or grey clay as in Unyamwesi The vegetation varies greatly according to the nature of the soil. The whole of this granitoid region is marked by the occurrence of monstrous blocks, generally rounded, and strewing the whole surface as if some great eruption

Section from S to N along west side of Tanganyika



(1) Variegated sandstones; (2) Intruded rocks and probable line of fault, (3) Sandstones smashed and tilted, (4 4) Felspathic rocks, (5 5) Fine grained brick-red sandstones with quartz pebbles, (6 6 6) Greywacke and other metamorphic rocks

had smashed the underlying rocks. Their presence, however, is not due to any such cause, the main agent having been rain and carbonic acid, assisted by rapid radiation acting along the joints and cracks.

It may be noted that at a number of points both in Ubena and Ugogo evidences of rocks erupted through the granites were obtained

Continuing our route to Nyassa over this plateau at a general height of about 5000 feet above the sea we are confronted by a sudden rise in the ground, which forms

apparently a second and higher plateau. The abrupt change of level, together with the alteration in the internal structure and the presence of intrusive rocks at the base of the mountain seem to point to the existence of a fault of considerable magnitude, which probably is the eastward extension of a great fault to be described further on.

The rocks composing this high tract of country consist mainly of clay-slates with the original bedding still very distinct. What may be their exact relations to the granites which they probably overlie, or to the metamorphic rocks of the coast-range, we have as yet no means of ascertaining. Careful research will be required before anything definite can be said about them. The mountains cut out of these rocks by denudation are rounded in form, smooth, and by no means picturesque. They are devoid of trees, but covered with grass

As we approach Lake Nyassa we observe evidence of much disturbance, till at a distance of about ten miles from the Lake we come upon the ancient pipe of a volcano, and five miles further on enter amongst a series of volcanic porphyrites, tuffs, and agglomerates forming mountains several thousands of feet in height, and which extend round the north end of the Lake. Along with this marked change of internal structure we have as decided a change in the scenery The rounded mountains with smooth, grassy, and uncut sides give place to jagged peaks, serrated ridges, sharp yawning valleys, and irregular, rocky, notched sides, forming a landscape of no ordinary description

The extraordinary series of volcanic rocks which form the magnificent mountains round the north end of Lake Nyassa probably belong to the same period as a similar series which characterise the Cape geology The latter have been assigned to the Trias, and doubtless the immense development of volcanic rocks in Abyssinia described by Blandford is of the same age. Indeed we might almost say we have connecting links between the two places, as on my return march through Ugogo I observed evidence of volcanic outbursts, and it is well known that Kilimanjaro, further north, is of volcanic origin. It seems then that in Triassic times a great line of volcanic action stretched from the Cape by Nyassa, Ugogo, and Kilimanjaro, to Abyssinia.

But at the north-west corner of Nyassa we have evidence of later volcanic activity. In a niche cut out of the surrounding plateau and on a comparatively level plain, through which the River Jumbaka winds to the lake, a number of beautifully isolated cones rise to a height of about 300 feet. On examination these prove to be perfect volcanic craters, so entire and symmetrical as to appear almost artificial One crater which I examined forms a beautifully bowl-shaped hollow, descending to the level of the plain, the bottom being a charming circular pond, where a number of hippopotamuses live

It is clear from the perfect shapes of these cones, and from the fact that the surface features of the surrounding country have remained unchanged since their origin, that they must have arisen in comparatively recent times. Besides these cones there are two pretty circular lakes, which also appear to have been originally volcanic craters.

On leaving this interesting country and proceeding on our way to Tanganyika we rise once more to the top of the plateau, cross over mountains 8000 feet in height, and then descend to a general level of from 4000 to 6000 feet. We pass over clay slates and schists whose relative positions could not be determined with intrusive masses of granite At one point an interesting section was revealed, showing the granite completely inclosing a mass of greenstone.

On nearing the south end of Lake Tanganyika we pass abruptly from these ancient rocks to red and variegated sandstones much hardened and broken, but preserving their original horizontal bedding. Rounding the end of the lake and continuing our march northward along its western side, we come to almost a sheer precipice, suddenly lowering the altitude from nearly 5000 feet to less than 3000. Running east and west along the precipice there occur intruded rocks, while on the northern or lower side of the precipice the sandstones almost disappear, being only represented by a small extent of crushed and tilted beds Such a condition of things clearly indicates the existence of a great fault. This theory is strengthened by a similar abrupt change of rocks on the eastern side of the lake, and it will be remembered that we have already noticed among a different series of rocks still further east a sudden change of level almost on the same parallel of latitude.

The sandstones thus abruptly brought to a finish in their extension northward are succeeded by felspathic rocks which form huge mountain masses both on the east and west sides of the lake. Near the middle of the lake on its western side there occurs a curious apparently isolated area of fine red sandstones, surrounded on all sides except the east by mountains of metamorphic and felspathic rocks. These sandstones would seem to have been deposited in a small lake eight miles in diameter. Mount Malumbi, figured in Stanley's "Dark Continent," belongs to the same formation.

Still proceeding along the lake we cross a high mountain range named Tchansa, formed of metamorphic rocks with felspathic rock in the centre We regain the sandstones once more in the country of Uguha The sandstones here, unlike those of the south end, are very red in colour, extremely friable, and marked by the abundance of quartz pebbles. Through this formation the Lukuga River finds its way to the Congo, its course determined not by any great convulsion as some travellers have been inclined to believe, but by the long-continued action of streams wearing down the soft and friable barrier which hemmed in the lake at this point These sandstones have an extension over a large area. They are found away towards Manyema and up the Congo Valley as far as Lake Moero, probably turning round and joining the strata we have noticed at the south end of Tanganyika On the east side they are found from Kaboga to the north of Ujiji, though here shales are not uncommon and the strata much curved

The absence of all fossils leaves the question of the age of these rocks in some mystery A reference to Cape geology may, however, as in the case of the volcanic rocks, throw some light on this subject. The Tanganyika sandstones have evidently been formed in an enormous inland lake, beside which the present African lakes would look insignificant

In Cape Colony a similar series of rocks occur of a lacustrine origin, and which have been assigned to a period not later than the Trias, and probably they belong to Palæozoic times In the absence of anything but lithological evidence we cannot do better than place the Tanganyika sandstones in the same era as the Cape series, an era which would seem to have been emphatically characterised by the presence of great lakes.

JOSEPH THOMSON

INCANDESCENT ELECTRIC LIGHTS

THE recent experiments of Mr. J. W. Swan of Newcastle-on-Tyne have gone far towards demonstrating the practicabilty of a system of electric lighting based upon the so-called principle of incandescence. As the solution of the whole question of the possible domestic application of electric lighting depends in all probability uppon the successful application of this method, these experiments have claimed already a considerable share of public attention, though no panic has yet arisen like

that created two years ago by the far less formidable experiments of Mr. Edison in the same direction.

The material which Mr. Swan proposes to render incandescent by means of an electric current is a "wire" of prepared carbon of extraordinary density and elasticity. Twenty years ago he prepared carbon filaments for the very same purpose from calcined cardboard, inclosing them in a glass vessel from which the air was withdrawn as perfectly as the imperfect air-pumps of that date permitted. In October 1877, or one year before Mr. Edison had begun to attempt the construction of lamps with carbonised paper, Mr. Swan had some prepared carbons mounted in glass globes and exhausted by the Sprengel air-pump by Mr. Stearn of Birkenhead. This enabled Mr. Swan to discover that when the carbon was properly fixed and heated during exhaustion so that the occluded gases might be expelled, there was an end of the causes that hitherto had seemed to defeat all attempts to utilise this method of procuring an incandescent electric light, for when these conditions were observed there was none of the disintegration of the carbon rods, nor of the blackening of the globes that with less perfect vacua had proved the ruin of carbon lamps. The filaments of carbon now produced by Mr. Swan indeed resemble steel wire rather than carbon, so extraordinary is their tenacity and texture. The secret of their manufacture has not yet been made known, being the essential point of the patent rights which Mr. Swan has just secured. Each filament is about three inches long, and not more than the hundredth of an inch in diameter, and is so slight as only to weigh from one-fifteenth to one-twentieth of a grain. The durability of these filaments is remarkable. In the course of a lecture delivered on November 25 last before the Society of Telegraph Engineers, Mr. Swan stated that he had had lamps lighted continuously since August 30, with an intermission of three weeks only, and that this seemed to be far from the actual limits of durability. When the currents employed are not too strong, the lamps will last longer. The light yielded by these lamps varies, according to circumstances, from thirty to fifty standard candles. On the occasion of Mr. Swan's lecture thirty-six of these tiny lamps were exhibited working by the current of a dynamo-electric machine requiring four horse-power to drive it. In the debate which followed Mr. Swan's communication, the remarks made by Prof. Tyndall, Dr. Hopkinson, Mr. Alexander Siemens, and others, showed the real value of the advance made by Mr. Swan. The question however of the economy of the system remains yet to be decided by the practical test of durability. At a previous lecture at Newcastle-on-Tyne Mr. Swan exhibited twenty lamps fed by a current generated by a gas-engine consuming 160 cubic feet of gas per hour. The light obtained exceeded that of the seventy gas-jets which usually supplied the same room, and which consumed 280 feet per hour. Mr. Swan proposes to connect these lamps in series of fifty or a hundred in one circuit, using automatic circuit-closers to close the circuit in the rare case of the failure of a lamp. He considers his method of arranging the system to be superior to that proposed by Mr. Edison, whose method of placing the separate lamps in single branches of a divided circuit would involve the use of very heavy and costly conducting-wires without any counterbalancing advantage. With this important difference Mr. Swan's further proposal to erect central stations from which to supply currents of electricity over large areas resembles that suggested by Mr. Edison. Should the anticipations of the inventor and the present promise of the new lamps be fulfilled, domestic electric lights will certainly become a fact at no distant date.

Meantime Mr. Edison has not been idle. It is stated that he is at present laying down a service of about seven miles in length upon which to test the success or failure of his system upon a large scale. He has developed several ideas since his last appearance before public notice. He now makes his dynamo-electric generators of a much larger pattern than any heretofore attempted. He has abandoned charred cardboard in favour of a filament of carbon prepared from a cultivated variety of the Japanese bamboo. We shall hear before long whether his indomitable perseverance has been rewarded with final success. In spite of being in point of date behind Mr. Swan, he has the enormous advantages of a unique workshop and laboratory under his own direction, of a wealthy company at his back, and of the extraordinary prestige won by his previous inventions. If Mr. Swan appears to be nearer to a genuine success, Mr. Edison has a popular reputation that of itself will win a hearing for the most trivial of his inventions. Whichever of the rival systems succeeds science and mankind are the gainers. But up to the present point it seems to us that beyond question Mr. Swan is nearer the goal of practical results than his famous rival.

It may interest our readers to know that Mr. Edison's first carbon lamp is now on view along with his original phonograph and his earliest tasimeter in the Patent Museum at South Kensington.

SUBTERRANEAN FOREST IN INDIA

THE accompanying notes and illustrations on the underground forest recently discovered in excavating the Prince's Dock, Bombay, were forwarded by Col. C. J. Merriman, R.E., C.S.I., Member of the Legislative Council, and Secretary to Government (Public Works Department), Bombay.

The trees were generally found in a dark loamy soil composed of underlying rock disintegrated. The upper

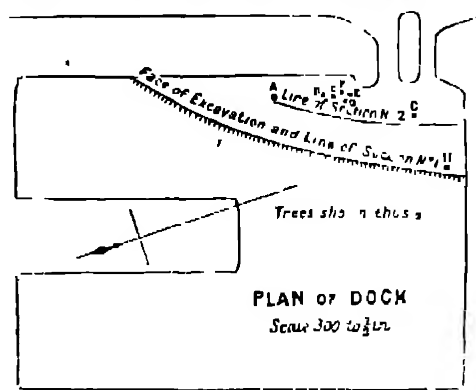


FIG. 1.—Dock.

portion of the trunks stopped at the soft black clay, which is silt. A few went a little way beyond, but as far as they protruded into the silt they were completely

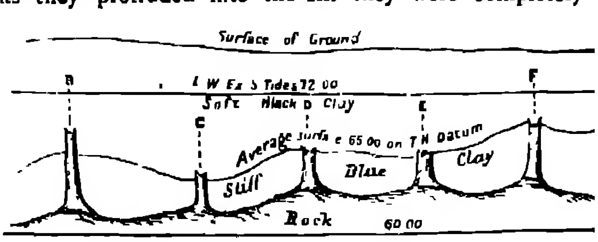


FIG. 2.—Section in line of trees B to F. Scale $\frac{1}{16}$ inch to 1 foot.

riddled by the teredo, the nearer the root the bigger the hole, showing that the boring began from the top.

The roots of the highest tree found were at 72·20 on T.H. datum, or close on Low Water extreme springs, about six feet under the surface of the mud. The lowest root was

at 55·93, or say sixteen feet under L.W. extreme springs, twenty-two feet under the surface of the mud

Inside the dock altogether were 382 trees, 223 standing, the remainder flat. The largest tree was forty-six feet long, and 4′ 6″ girth; it was flat None of the trees would girth over 4′ 6″. The soil in which many of them stood was only 6″ to 9″ thick over the rock. The wood is apparently black wood. The roots presented a peculiar appearance, being nearly at right angles to the trunks

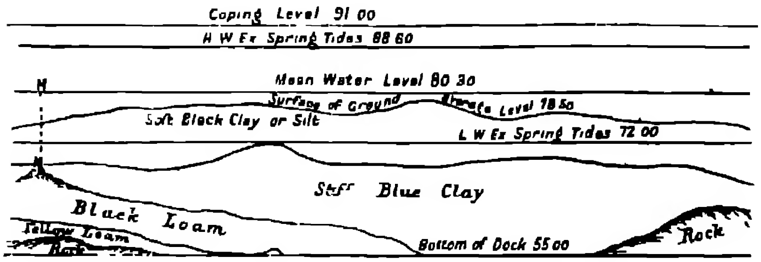


FIG 3 —Section No 1 Scale—Vertical 15 feet to ⅛ inch, horizontal 150 feet to ⅛ inch

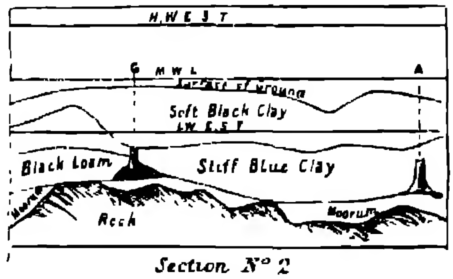


FIG 4 —Section No 2

The forest seems to have stopped at the gates, as very few trees were brought up in the dredging operations.

The mixture of different kinds of stone is curious. In small patches we find trap, which gives way to moorum, and then a sort of pudding-stone mixed up with black and red stuff so hard that it cuts the divers' hands as with a knife.

NOTES

PROF. HELMHOLTZ has been appointed Faraday Lecturer for 1881, the lecture will be given early in April

WE greatly regret to announce the death of Sir Benjamin C. Brodie, Bart, F R S., the eminent chemist and late Professor of Chemistry in the University of Oxford He died on Wednesday, last week, at Torquay, in the sixty-fourth year of his age. We hope to be able to give a detailed notice of Sir Benjamin's life and work in a future number.

THE death, on Sunday, is announced of Mr Mark Firth, at Sheffield, in the sixty-second year of his age Mr Firth was eminent for his discriminating liberality, and will be specially known to our readers as the founder of the well-known Firth College, Sheffield, opened by Prince Leopold last year

PROF. J CHARLES D'ALMEIDA, whose sudden death at Paris we mentioned a fortnight since, was one of the prominent leaders in the scientific circles of the French capital. Formerly a Professor of Physics in the Lyceum of Henry IV, he had occupied for some years past the important and responsible position of Inspector-General of Public Instruction. A strong Liberal in matters of education, he exercised a marked influence in the late reorganisation of the French educational system. It was almost entirely owing to his efforts that the Société Française de Physique owes its creation, and since its origin he has occupied the post of secretary. As an investigator D'Almeida is best known by his valuable researches on the phenomena of electrolysis, on galvanic batteries, on capillary phenomena, &c. One of the most remarkable services he has rendered was the invention of the photographic despatches by means of which, during the siege of Paris, the inhabitants of the city were enabled to avail themselves so extensively of the otherwise limited services of the "pigeon post."

A SHORT time ago we alluded to the severe loss to chemical and technical literature by the death of Prof von Wagner, who for twenty-five years past has conducted so ably his admirable *Jahresbericht für die chemische Technologie* The difficult question of finding a successor in the editorship of this important annual has been happily solved by the choice of Dr. Ferd. Fisher, Professor of Technology at the Polytechnic of Hanover. For a long time past Prof. Fisher has rendered valuable literary services in editing *Dingler's Polytechnisches Journal*, the most important technical publication on the Continent. As an investigator he is also well known by his elaborate researches on water in its technical and physiological relations, on pyrometry, and on numerous other chemical and technical questions. Under the new auspices the *Jahresbericht* has every reason to look forward to a continuance of its successful career.

M. CHARCOT reopened last week his course of botany at Salpetrière, where he exhibited last year the curious phenomena of female patients suffering from neuro-mental affections New instances will be produced of cures analogous to the troubles regarded in mediæval times as produced by demoniacal agency or cured by witchcraft.

IN a lecture on earthquakes delivered in Vienna on the 22nd inst, Prof. v Hochstetter designated the Agram earthquake (affecting elliptically a region of 60 to 80 German miles diameter, and having its larger axis directed south-south-west to north-north-east) as a tectonic or dislocation-earthquake—a name which originated with the Austrian geologist Prof Hornes. Prof. Suss expressed a similar opinion in a lecture on November 24, "On Earthquakes in the Alps."

ON Sunday evening, about six o'clock, slight shocks of earthquake were felt at two different places in Scotland—one being Callander, in Perthshire, and the other Inverary, in Argyllshire. The two districts affected are about forty miles apart, in a line due east and west The shock was also felt at Rothesay and Stornoway. In the north of Ireland during Sunday evening and also the earlier hours of yesterday morning several decided shocks of earthquake were felt, especially in Londonderry and its vicinity. The disturbance was more particularly felt at Innishowen, and it seemed to travel across the bed of the River Foyle to the County Derry side, where the effects were felt strongly.

AT DORTMUND there was a slight shock of earthquake on November 25, and a smart one on the 27th.

MR. MUNDELLA has been speaking on education again, repeating essentially the old story, that our country must lose in the race unless, as in other countries, education in science is made an imperative part of elementary education. We have many natural and traditional advantages over other countries, but all these must in the long run succumb to scientific training.

A MAGNIFICENT lacustrine find has been made in the marshes of Corcelletes, near Consise, in Canton Vaud. It consists of a

fine canoe in a perfect state of preservation, 11 metres 16 centimetres long, and slightly more than a metre broad. It was dug out and drawn from the marsh by sixty men and eight oxen, under the superintendence of the director of the Museum of Lausanne, and has been placed in the court of the Lausanne Academy, where it is destined to remain.

WE have before us the reports for last year of the two clubs which have for their object the furtherance of the special study of British plants and their distribution over the surface of the islands. The Botanical Exchange Club has been in existence about twenty-five years, and was a continuation of the London Botanical Society. The Secretary sends out each spring a list of the plants that are wanted, and the members, who are about thirty in number, at Christmas send in their parcels and lists of desiderata. All doubtful specimens are submitted to competent referees, and after the distribution is made a report is published on critical forms and extensions of distribution. The most interesting find noticed this year is the discovery of *Herniaria hirsuta*, a plant spread widely through the southern half of Europe, by Mr. Fred. Townsend at Christchurch, in Hampshire. Dr. Boswell identifies the prickly comfrey, which has been so much talked about lately as a forage plant, with the *Symphytum uplandicum* of Nyman. Probably it is really a hybrid between *S. officinale* and *S. asperrimum*, as was suggested lately when it was figured by Sir Joseph Hooker in the *Botanical Magazine* Some curious observations have been made lately tending to show that our wild docks hybridise naturally not unfrequently, like verbascums, geums, primulas, thistles, and epilobia. There is a curious form of *Ophioglossum* (*O vulgatum*, var. *ambiguum* of Cosson and Germain), which till now has been known in Britain only in the Orkney and Scilly Islands. This year Mr Chas. Bailey has found it on the Welsh coast between Harlech and Barmouth The Botanical Record Club has for its object the filling up of the blanks left by Mr. Watson when he traced out in detail the home-distribution of British plants in his "Cybele Britannica.' In the report for this year detailed lists are given for Cardiganshire and Peeblesshire, and the only counties for which lists of flowering plants now remain to be drawn up are Flintshire, Wigtonshire, and West Ross. Fourteen pages of the present report are occupied by fresh records for counties already worked up, and the Club is now turning its attention to the distribution of the lower cryptogamia, especially mosses. The registration of flowering plants is in the hands of Dr F A. Lees of Wetherby, and of mosses in that of Mr. H. Boswell of Oxford, and the Secretary of both the Clubs is Mr Chas. Bailey, F L.S, of Manchester

MR. BRIAN HOUGHTON HODGSON, F R.S, has just presented to the Anthropological Institute a valuable portfolio of drawings illustrative of the Eastern Himalayas and Tibet The drawings have been made by the same Nepalese draughtsman as delineated the zoological drawings which have been presented to the Zoological Society, and this ethnological series comprises and contains in all 521 subjects, including duplicates A series of crania have been drawn by aid of the camera, Mr. Hodgson remarking "native patience, hand and eye being peculiarly fitted to work that instrument."

ETIENNE MULSANT, one of the most prominent of French entomologists, and librarian to the city of Lyons, died on November 4 at the great age of eighty-four. His earliest publication was the "Lettres à Julie sur l'Entomologie (en prose et en verse)," published in 1830, but for the most part consisting of real love-letters to the lady he afterwards married, and written before he was out of his teens. His writings are most voluminous, but he was best known as the author of a work extending over nearly forty years, on the *Coleoptera* of France, and published (chiefly) in the *Annales* of the Linnean Society of Lyons. He was also the author of a magnificently illustrated work on Humming Birds, in connection with which he visited London about five years ago.

WE learn that Messrs Williams and Norgate are about to issue an important work on the Fishes of Great Britain and Ireland by Dr. Francis Day, late Inspector General of the Fisheries of India. This work deals with their economic uses, modes of capture, diseases, breeding, life history, &c., with an introduction on the structure of fishes generally, their functions and geographical distribution. The first part appears this month, and is illustrated by twenty-seven plates. The whole will form a work of 700 pages royal octavo, with over 200 plates

THE exploration of the remains of prehistoric man is being actively carried out in Russia. We have already briefly noticed a contribution to this subject by M. Mereshkovsky, published in the *Izvestia* of the Russian Geographical Society (vol xvi No 2), being a report upon the exploration of caverns and rock shelters in the Crimea, in the neighbourhood of the Tchatyrdagh Mountain A great cavern, 145 feet wide and 58 feet deep, was explored close by the Suren town, and M. Mereshkovsky found there the remains of a prehistoric workshop for the manufacture of stone implements, the whole belonging to two distinct periods. The paper by M. Mereshkovsky, published in the *Izvestia*, is accompanied with four tables of drawings of stone implements

WE notice the following interesting communications which were made at the last meeting of the St Petersburg Geological Society:—On the motion of downs near Sestroretsk, by M Sokoloff. The velocity of these downs is about one foot per month.—On the excavations made by water in rivers and springs of Northern Esthonia, especially by the waterfalls near Reval, Yagowal, and Fal; and on the Devonian clays discovered by Prof. Inostrantseff in the cuttings of the new Ladoga canal. The upper parts of the beds of these clays are bent by the action of the ice of the ice period, as has been observed at many places in Great Britain, the peats which cover the glacial formations are full of remains of prehistoric man.

WE can state that the Observatory of Algiers will not remain longer without an astronomical observer M. Tripier, who has been appointed director, as has been announced in the French papers, will leave in time for installation at the meeting of the French Association for the Progress of Science in April, 1881

THE purchaser of the French Siemens patent is preparing to send a tender for establishing an electric railway from the Exhibition to the central parts of Paris

ABNORMAL VARIATIONS OF BAROMETRIC PRESSURE IN THE TROPICS, AND THEIR RELATION TO SUN-SPOTS, RAINFALL, AND FAMINES[1]

II.

Comparison of the Abnormal Barometric Variations with the Sun-Spots

A GLANCE at the barometric and sun spot curves is sufficient to show that the irregular and frequent fluctuations of pressure are relatively much larger than those of the sun-spots In order therefore to compare the general course of the barometric curves with that of the sun-spot curve the numbers of Table I have been further smoothed by taking the means of every nine consecutive quarterly values of the nine monthly means. The results of this operation are given in the following table, and graphically represented by the dotted curves which are drawn through the continuous ones. All these dotted barometer curves closely resemble each other, except that portion of the Mauritius curve after the year 1865 which shows a tendency to assume an opposite character. They are also very similar to the sun-spot curve, but all of them lag very persistently behind the latter, as will be seen by comparing the points marked with the same capital letters.—

[1] Continued from p 91

TABLE II.

Means of every Nine Consecutive Quarterly Values of the Nine-Monthly Means of Solar Spotted Area and Abnormal Barometric Pressure

Year		Solar spotted area in millionths of visible hemisphere	Abnormal barometric pressure in thousandths of an inch					
			St. Helena	Bombay	Madras	Calcutta	Batavia	Zi-ka-wei
1841	1							
	2	396						
	3	359						
	4	316						
1842	1	284	− 5					
	2	244	− 4					
	3	216	− 3		− 6			
	4	188	− 1		− 5			
1843	1	171	0		− 4			
	2	164	0		− 3			
	3	161	− 1		0			
	4	164	− 1		+ 2			
1844	1	182	0		+ 4			
	2	208	+ 2		+ 5			
	3	235	+ 4		+ 6			
	4	268	+ 5		+ 8			
1845	1	319	+ 6		+ 11			
	2	378	+ 7		+ 13			
	3	426	+ 8		+ 14			
	4	480	+ 8		+ 14			
1846	1	530	+ 8		+ 12			
	2	582			+ 10			
	3	658			+ 9			
	4	762			+ 6			
1847	1	856			+ 2			
	2	911			− 3			
	3	946			− 6			
	4	1005			− 9			
1848	1	1053			− 11			
	2	1080			− 13			
	3	1071		− 7	− 15			
	4	1022		− 8	− 17			
1849	1	947		− 7	− 17			
	2	866		− 6	− 16			
	3	804		− 4	− 16			
	4	762		− 4	− 15			
1850	1	709		− 4	− 14			
	2	662		− 5	− 11			
	3	626		− 6	− 10			
	4	611		− 7	− 8			
1851	1	610		− 6	− 6			
	2	604		− 6	− 5			
	3	602		− 6	− 2			
	4	598		− 7	− 1			
1852	1	585		− 7	+ 1			
	2	560		− 6	+ 2			
	3	532		− 5	+ 4			
	4	498		− 1	+ 6			
			Mauritius					
1853	1	452		+ 1	+ 8			
	2	392		+ 3	+ 9			
	3	346		+ 3	+ 8			
	4	312		+ 2	+ 7			
1854	1	281		+ 2	+ 8			
	2	239		+ 4	+ 7			
	3	191	− 12	+ 5	+ 8	− 1		
	4	147	− 8	+ 6		+ 1		
1855	1	113	− 6	+ 6		+ 3		
	2	93	− 7	+ 5		+ 3		
	3	82	− 8	+ 3		+ 3		
	4	70	− 10	+ 3		+ 2		
1856	1	57	− 11	+ 3		− 1		
	2	52	− 11	+ 1		− 5		
	3	67	− 12	0		− 6		
	4	106	− 14	− 1		− 6		

Year		Solar spotted area in millionths of visible hemisphere	Abnormal barometric pressure in thousandths of an inch					
			Mauritius	Bombay	Madras	Calcutta	Batavia	Zi-ka-wei
1857	1	161	− 15	− 2		− 5		
	2	224	− 16	− 2		− 7		
	3	309	− 15	− 2		− 7		
	4	422	− 11	+ 1		− 5		
1858	1	543	− 4	+ 3	+ 12	0		
	2	669	+ 3	+ 5	+ 15	+ 4		
	3	814	+ 6	+ 7	+ 16	+ 9		
	4	957	+ 7	+ 7	+ 16	+ 10		
1859	1	1065	+ 6	+ 5	+ 14	+ 8		
	2	1145	+ 3	+ 4	+ 12	+ 6		
	3	1221	+ 2	+ 4	+ 9	+ 4		
	4	1289	+ 1	+ 2	+ 7	+ 2		
1860	1	1325	− 2	− 1	+ 2	− 1		
	2	1356	− 7	− 4	− 5	− 7		
	3	1369	− 12	− 6	− 6	− 12		
	4	1347	− 16	− 8		− 15		
1861	1	1296	− 17	− 8		− 17		
	2	1289	− 17	− 9		− 16		
	3	1292	− 17	− 11		− 15		
	4	1292	− 20	− 15		− 16		
1862	1	1237	− 21	− 18		− 17		
	2	1161	− 22	− 18		− 17		
	3	1060	− 21	− 19		− 18		
	4	983	− 21	− 18		− 19		
1863	1	930	− 19	− 16		− 19		
	2	922	− 15	− 15		− 18		
	3	867	− 11	− 9		− 17		
	4	821	− 5	− 4		− 14		
1864	1	747	+ 1	+ 1		− 8		
	2	702	+ 6	+ 5		− 2		
	3	668	+ 11	+ 8		+ 3		
	4	672	+ 14	+ 11		+ 8		
1865	1	657	+ 15	+ 13		+ 11		
	2	618	+ 15	+ 12		+ 13		
	3	528	+ 15	+ 11		+ 13		
	4	452	+ 16	+ 9		+ 14		
1866	1	367	+ 17	+ 8		+ 14		
	2	308	+ 17	+ 8		+ 13		
	3	274	+ 16	+ 9		+ 12		
	4	262	+ 13	+ 11		+ 13		
1867	1	248	+ 11	+ 14		+ 15		
	2		+ 9	+ 16		+ 19		
	3		+ 8	+ 18		+ 21	+ 12	
	4		+ 8	+ 21		+ 23	+ 15	
1868	1		+ 7	+ 22		+ 23	+ 17	
	2		+ 7	+ 22		+ 22	+ 18	
	3		+ 8	+ 22		+ 20	+ 18	
	4		+ 9	+ 19		+ 18	+ 17	
1869	1		+ 11	+ 15		+ 13	+ 15	
	2		+ 12	+ 10		+ 8	+ 10	
	3		+ 14	+ 7		+ 4	+ 6	
	4		+ 16	+ 2		+ 1	+ 2	
1870	1		+ 18	− 3		− 1	− 3	
	2		+ 20	− 6		− 3	− 6	
	3		+ 20	− 8		− 5	− 8	
	4		+ 22	− 8		− 6	− 10	
1871	1		+ 23	− 7		− 6	− 10	
	2		+ 22	− 6		− 3	− 9	
	3		+ 21	− 5		0	− 9	
	4		+ 19	− 7		0	− 10	
1872	1		+ 16	− 7	− 11	0	− 11	
	2		+ 13	− 7	− 11	− 2	− 12	
	3		+ 11	− 6	− 11	− 1	− 12	
	4		+ 10	− 5	− 10	− 1	− 11	
1873	1		+ 6	− 4	− 10	0	− 9	
	2		+ 4	− 2	− 9	+ 1	− 8	
	3		+ 2	− 2	− 10	+ 1	7	
	4			− 2	− 10	+ 2	− 7	
1874	1			0	− 10	+ 2	− 5	
	2			+ 1	− 9	+ 2	− 3	
	3			+ 2	− 8	+ 3	− 1	− 5
	4			+ 2	− 8	+ 2	− 3	− 7

TABLE II. (*Continued*)—

Year		Solar spotted area in millionths of visible hemisphere.	Abnormal barometric pressure in thousandths of an inch. Mauritius	Bombay	Madras	Calcutta	Batavia	Zi-ka-wei
1875	1			0	−10	0	−4	8
	2			−1	−12	−2	−6	−9
	3			−1	−13	−3	−7	−9
	4			+2	−10	−1	−4	−8
1876	1			+6	−5	+2	+1	7
	2			+13	+3	+7	+7	−6
	3			+16	+10	+13	+13	−3
	4			+20		+17	+18	+2
1877	1			+23		+24	+23	+8
	2			+25		+31	+26	+13
	3			+23		+37	+26	+16
	4			+18		+38		+16
1878	1			+11		+32		+14
	2			+7		+26		+13
	3			+1		+21		+12
	4			−4		+16		+9
1879	1			−9		+11		
	2							
	3							
	4							

The epochs of maximum and minimum barometric pressure and of minimum and maximum sun-spot area, as determined from the dotted curves by the graphic method, are given in the following table —

Epochs of Maximum and Minimum Barometric Pressure and Solar Spotted Area

Solar spotted area	Barometric pressure: St. Helena	Mauritius	Bombay	Madras	Calcutta	Batavia	Zi-ka-wei
Min in July 1843	Max in Nov 1845	—	—	Max. in Aug 1845	—	—	—
Max in May 1848.	—	—	Min in Sept 1848.	Min in Dec 1848	—	—	—
Min in April 1856	—	Max in Oct. 1858	Max. in Aug 1858	Max. in Aug 1858.	Max. in Sept 1858.	—	—
Max in June 1860.	—	Min. in April 1862	Min. in Aug 1862	—	Min. in Jan 1863	—	—
Min in February 1867.	—	?	Max. in May 1868.	—	Max in Nov. 1867	Max in May 1868	—
—	—	?	Min. in Sept. 1870.	—	Min. in Nov. 1870.	Min. in Dec 1870	—
—	—	—	Max. in April 1877.	—	Max in Sept. 1877	Max in May 1877.	Max in Sept. 1877.

The mean epochs are given below and compared with those of the solar spotted area.

Mean Epochs of Barometric Pressure compared with the Corresponding Epochs of Solar Spotted Area[1]

Solar spotted area			Barometric pressure			Difference	
	a			b		$b-a$	
	Year	Month		Year	Month	Year	Month
Min.	1843	7·5	Max	1845	10·0	+2	2·5
Max.	1848	5·5	Min	1848	11·0	+0	5·5
Min.	1856	4·5	Max	1858	9·2	+2	4·7
Max.	1860	6·5	Min	1862	8·8	+2	2·3
Min.	1867	2·5	Max.	1868	3·5	+1	1·0
				Mean		+1	8·0

From this comparison it appears that the epochs of maximum and minimum barometric pressure lagged behind the corresponding epochs of minimum and maximum solar spotted area at an interval varying from above six months to nearly two and a half years, or at an average interval of about one year and eight months.

Making use of this result and comparing points of the pressure curves with points of the solar curve several months earlier, it will be seen that even the minor peculiarities of the pressure curves from 1863 to 1868 do bear some resemblance to the subordinate features of the sun-spot curve from 1862 to 1867. What appear to be corresponding points have been marked with corresponding letters. It is remarkable that this part of the sun-spot curve is the very portion which has been most accurately determined by means of the Kew photoheliograph.

Comparison of the Abnormal Barometric Variations with Past Famines.—According to the Report of the Famine Commission the famine of 1876-78 in Southern India was *the most widespread and severe* of any which have occurred in India during the present century, and on reference to the curves it will be seen that the abnormal barometric pressure during those years was the *highest on record*. In the year 1878 a famine occurred in the North West Provinces also, in consequence of a deficiency of rain in the previous year.

The famine next in severity to that of 1876–78, and of even greater extent, was the one of 1868–69, which affected Rajputana and the North-West Provinces. The curves show that this also was accompanied or immediately preceded by a *wave of high barometric pressure*, which reached its maximum near the middle of the year 1868.

The next on the list of severe famines is that which occurred in Orissa in the years 1865–66, and it will be seen that this also was attended by a *wave of high pressure* which slowly passed over India in the years 1864–65.

The less extensive Behar famine of 1873-74 was also accompanied by a small wave of high pressure, which, judging from the curves for Mauritius, Bombay, Madras, and Batavia, reached its maximum height towards the end of 1873.

The famine of 1860-61 in the North-West Provinces was also preceded by a wave of high pressure in the year 1859, although the failure of the rains which induced this famine did not occur till the following year.

The above mentioned famines include *all* the severe ones that have occurred in India since 1841, the year from which barometric data exist; and the waves of high barometric pressure which have been mentioned in connection with them include *all* that have been observed except two, viz. the one in 1855 and the one in 1845, both of which, though not immediately followed by actual famine, were nevertheless accompanied by deficient rainfall both at Madras and Bombay, the fall at the former station being 67 and 78 per cent. of the average in 1855 and 1845 respectively, and at the latter station 58 and 77 per cent. in the same years. Between the years 1832 and 1840, during which the solar spotted area was accurately observed, but for which period I have no barometric data, two other severe famines occurred, viz. the Guntur famine of 1833, and the famine of 1837-38 in Northern India; and it is worthy of note that the first of these occurred soon after the sun-spots had somewhat suddenly fallen to a minimum in 1832, and when, therefore, the barometric pressure would assumably be high, the second soon after the great and sudden diminution of spots which took place early in the year 1837. This last occurrence was very similar to the great decrease of spots observed in 1863, on which occasion

[1] The numbers 1, 2, 3, &c., under the heading "Month," refer to the months January, February, March &c., respectively, and the decimals of a month are reckoned from the beginning of the respective months.

the decrease was followed by the wave of high pressure which preceded the Orissa famine.

Hence it appears that widespread and severe famines are generally accompanied or immediately preceded by waves of high barometric pressure.

Means whereby future famines may possibly be foreseen.—If the conclusions arrived at from the above comparisons of abnormal barometric variations, sun-spots, and past famines be admitted, it is clear that they at once present the means whereby future famines may possibly be foreseen. The conclusions are briefly:—

1. That variations of the solar spotted area are *succeeded many months afterwards* by corresponding abnormal barometric variations.

2. That abnormal barometric variations in the tropics travel at a very slow rate round the earth from west to east, arriving at westerly stations *several months before* they reach more easterly ones.

3. That famines follow in the wake of waves of high barometric pressure.

Hence it follows that there are two methods by which early intimation of the approach of those meteorological disturbances which are attended by famines may possibly be obtained—

1. By regular observation of the solar spotted area, and early reduction of the observations, so as to obtain early information of current changes going on in the sun.

2. By barometric observations at stations differing widely in longitude, and the early communication of the results to stations situated to the westward.

With regard to the first of these methods it is sufficient to state that the whole subject of solar observations is now being investigated by a committee of scientific gentlemen in London, and we may therefore hope that the all-important information which solar observations are capable of affording will ere long be at our disposal; but with regard to the second method, viz., that of barometric observations at stations differing widely in longitude, it is to be regretted that no observatories of long standing situated in suitable localities to the *westward* of Bombay at present exist, except possibly at the very distant station of Havanna in Cuba. The observatory at St. Helena appears to have been closed in the year 1847, after working continuously for about seven years.

The most suitable localities for barometric observations for the purpose in view are insular stations far removed from the disturbing influences of the large continents and near the equator, such as the Seychelles, St Helena, and Ascension, but these appear to be at present unoccupied by permanent observatories, while the wide expanse of the Pacific, which is probably the most suitable portion of the earth's surface for investigations of this kind, appears to be entirely unrepresented by any fixed observatory on any of its numerous islands, such as the Galapagos, Sandwich, and Fiji Islands. An observatory has however lately been established at Zanzibar on the East Coast of Africa, from which very valuable observations may be expected if it should continue at work for any great length of time, and another has, I believe, been started at Aden: but as these stations are both situated on the borders of extensive continents, they are not so suitably located as the stations previously mentioned.

It would therefore be necessary, in order to utilise to the fullest extent the second method of foreseeing the approach of a meteorological disturbance of the kind which would probably be attended by famine, that special arrangements should be made for the registration of the needful observations at some, if not all, of the stations that have been referred to, and that the information thus afforded should be rapidly communicated from the more westerly to the more easterly stations.

F. CHAMBERS,
Meteorological Reporter for Western India

Bombay, September 4

POSTSCRIPT.—In order to determine numerically the intervals of time at which the barometric variations of one station have lagged behind those of another, and behind corresponding minor variations of the sun spots, the times at which the continuous curves cross the dotted ones have been marked off by the graphic method for corresponding crossing points of the different curves, giving the first set of times and intervals in each of the following tables. The same thing has been done with regard to the times at which the continuous curves cross the respective zero lines, giving the second set of times and intervals in each of the tables. As the average pressures for Batavia and Bombay have not been calculated from the observations of the same years, and as the zero line of the Batavia curve is on this account relatively displaced by ·004 of an inch in the upward direction, a new zero line has been drawn so as to make the times at which the continuous curve crosses the zero line comparable with those for Bombay. The approximate longitudes of the stations and their differences are also given in the tables.

Station	St Helena		Madras		Madras minus St Helena
Longitude	5° 44′ W		80° 14′ E		+ 85° 58′
	Year	Month	Year	Month	Month
First Set	1842	4·1	1842	9·7	+ 5·6
	1843	11·6	1843	12·8	+ 1·2
	1846	3·2	1846	7·1	+ 3·9
Second Set	1842	6·8	1842	11·5	+ 4·7
	1843	11·4	1844	1·9	+ 2·5
	1846	6·7	1846	9·1	+ 2·4
				Mean	+ 3·38

Station	Mauritius		Calcutta		Calcutta minus Mauritius
Longitude	57° 31′ E		88° 25′ E		+ 30° 54′
	Year	Month	Year	Month	Month
First Set	1856	3·6	1856	6·5	+ 2·9
	1857	5·2	1857	7·3	+ 2·1
	1858	10·5	1858	10·1	− 0·4
	1859	9·1	1860	1·0	+ 3·9
	1861	4·7	1861	9·0	+ 4·3
	1862	4·1	1862	9·5	+ 5·4
	1863	8·0	1864	6·0	+ 10·0
Second Set	1856	1·1	1856	4·7	+ 3·6
	1858	9·0	1858	6·8	− 2·2
	1859	9·8	1859	11·0	+ 1·2
	1863	10·5	1864	5·9	+ 7·4
				Mean	+ 3·47

Station	Bombay		Calcutta		Calcutta minus Bombay.
Longitude	72° 48′ E		88° 25′ E		+ 15° 37′
	Year	Month	Year	Month	Month
First Set	1856	2·5	1856	6·5	+ 4·0
	1857	7·2	1857	7·3	+ 0·1
	1858	5·0	1858	2·8	− 2·2
	1858	8·9	1858	10·1	+ 1·2
	1859	7·5	1859	10·7	+ 3·2
	1861	7·5	1861	9·0	+ 1·5
	1862	6·7	1862	9·5	+ 2·8
	1863	11·1	1864	6·0	+ 6·9
	1865	1·8	1865	9·3	+ 7·5
	1866	1·1	1866	10·2	+ 9·1
	1867	1·5	1867	7·0	+ 5·5
	1867	12·8	1867	10·8	− 2·0
	1869	6·9	1869	8·7	+ 1·8
	1870	6·9	1870	7·1	+ 0·2
	1876	10·1	1876	9·3	− 0·8
	1878	5·4	1878	8·8	+ 3·4

Second Set.	1856	3·1	1856	4·7	+ 1·6
	1857	7·8	1857	9·1	+ 1·3
	1859	9·2	1859	11·0	+ 1·8
	1863	11·5	1864	5·9	+ 6·4
	1869	8·2	1869	9·2	+ 1·0
	1876	4·8	1876	7·8	+ 3·0
	1878	5·9	1878	10·5	+ 4·6
				Mean	+ 2·69

Station	Bombay		Batavia		Batavia minus Bombay
Longitude	72° 48′ E		106° 53′ E		+ 34° 5
	Year	Month	Year	Month	Month
First Set.	1867	12·8	1868	2·1	+ 1·3
	1869	6·9	1869	8·5	+ 1·6
	1872	4·5	1872	5·6	+ 1·1
	1873	5·8	1873	6·8	+ 1·0
	1874	5·4	1874	6·7	+ 1·3
	1875	3·7	1875	4·9	+ 1·2
	1875	9·7	1875	10·0	+ 0·3
	1876	10·2	1876	9·8	− 0·4
Second Set.	1869	8·1	1869	10·0	+ 1·9
	1873	6·2	1873	7·5	+ 1·3
	1874	5·7	1874	7·5	+ 1·8
	1875	4·0	1875	6·0	+ 2·0
	1875	11·2	1875	9·7	− 1·5
	1876	4·9	1876	6·1	+ 1·2
	1878	5·9	1878	7·9	+ 2·0
				Mean	+ 1·07

	Solar spotted area.		Bombay barometer		
	Year	Month	Year	Month	Month
First Set.	1862	3·4	1862	6·7	+ 3·3
	1863	1·3	1863	11·1	+ 9·8
	1863	11·7	1865	1·8	+ 14·1
	1864	12·7	1866	1·1	+ 12·4
	1865	9·4	1867	1·5	+ 16·1
	1866	6·0	1867	12·8	+ 18·8
				Mean	+ 12·4

	Solar spotted area		Madras barometer		
	Year	Month	Year	Month	Month
First Set	1849	6·7	1849	12·8	+ 6·1
	1850	11·2	1851	5·4	+ 6·2
				Mean	+ 6·1

It will be seen that in the great majority of cases the barometric waves reach the westerly station several months before they arrive at the more easterly one, but that the rate of progression of these waves across the Indian Peninsula appears to be much slower than across the open ocean to the southward

F. C.

THE ROYAL SOCIETY—ADDRESS OF THE PRESIDENT[1]

DR SPOTTISWOODE began by referring to the losses which the Society has sustained by death during the past year:—Prof. Miller, Dr Sharpey, Mr Lassell, Prof Ansted, Lord Belper, Mr E W. Cooke, and Sir Benjamin Collins Brodie.

The Society's finances generally are, as the balance sheet will show, in a healthy condition, and appear to justify the hope that they will suffice for the large claims upon them for printing our publications The address then proceeds:—

Although we are more concerned, Dr Spottiswoode said, with the quality than with the quantity of communications made to the Society, it may not be without interest to observe that the number of papers received this year has been in excess of that in any previous year, at all events since 1872, inclusive. The following is a table of the numbers during the last nine years —

1872	99	papers received
1873	92	,, ,,
1874	98	,, ,,
1875	88	,, ,,
1876	113	,, ,,
1877	97	,, ,,
1878	110	,, ,,
1879	118	,, ,,
1880	123	,, ,,

and we may conclude that these have contained good matter from the fact that of the *Philosophical Transactions* for the current year Parts i and ii., already published, contain no less than 900 pages and thirty-three plates.

Dr Spottiswoode then referred to the satisfactory results of the change of time of meeting of the Society, and went on to speak of the death of Mr Henry White, who for many years was chief assistant in the compilation of the great Catalogue of Scientific Papers. At an earlier stage of the work, Dr. Spottiswoode went on to say, his loss would have been still more serious, but in a long course of training he succeeded so well in imparting his own careful and methodical mode of work to those under him, that the Council felt justified in making trial of his son to take his place With the result of this trial, as shown in continuing the preparation of a new edition of the catalogue of the Society's Library, the Council has reason to be satisfied Of this new edition, the first portion, 220 pages, containing our large collection of *Transactions* and *Proceedings* of Academies and Societies, and other scientific periodicals is in type, and will shortly be printed off. The verification of titles of our scientific books generally is so far advanced as to warrant the expectation that a large instalment of this portion of the catalogue will soon be in the printer's hands; after which we anticipate no further delay

In regard to the Library, a question has arisen as to how far purely literary works, which occupy much space, should be retained. Among them there are doubtless some which add neither to the utility nor to the scientific importance of our Library, but there are also some early printed books, bibliographical treasures, which are worthy of a place in any collection. It is proposed to have these carefully put in order, and to place them in a case by themselves. Among these, there may be mentioned —

Caxton's Chaucer, 1480.
Pynson's Chaucer, 1492
Speght's Folio Chaucer, 1598.
Ciceronis Officia et paradoxa, Fust, 1466, vellum
The generall historie of Virginia, Lond 1632
Bonifacius. Sextus decretalium liber. Ven. 1566 7
Plautus, 1482. Seneca, 1490
Ovid, 1485 Statius, 1490.
Plutarch, 1485. Herodotus, 1494
Homer, 1488.

For bringing into prominence these as well as other features of our miscellaneous, *i e.* non scientific, books, we are greatly indebted to the care and knowledge brought to bear on the subject by Mr. Tomlinson, and by our treasurer.

Although it is doubtless undesirable to propose, without sufficient cause, alterations in our statutes, or even in our practice, it is still often worth while from time to time to discuss questions involving such alterations in order that we may be prepared for a

[1] Address of William Spottiswoode, D C L, LL D, the President, delivered at the Anniversary Meeting of the Royal Society on Tuesday, November 30, 1880

deliberate judgment whenever occasion may arise. Among such subjects there is one upon which I have often heard opinion expressed, and upon which opinion has always weighed in the same direction: I allude to the period of office of those elected to serve on the Council of the Society. By the terms of our charter ten of the ordinary members retire every year; and as it is our custom to remove six according to seniority and four in respect of least attendance, it rarely happens, although the contrary is possible, that any Fellow, except those holding the posts of President, Treasurer, or Secretary, should remain in office more than two years. Experience, however, appears to show, that for a member serving on the Council for the first time, there is so much to learn, so many heads of business which do not in general come before the Fellows at large, that his first year is occupied quite as much in ascertaining his duties as in actively performing them This objection is in some degree met by selecting for the ten incoming members five who have served before, and five who have not so served, but, nevertheless, there is usually an interval of several years between two periods of office, and as a matter of fact we often lose a member of Council at the moment when his advice is becoming most valuable to our body.

I am aware of the great convenience attaching to our present impersonal mode of selecting the members to retire in each year, and am not at present prepared to suggest any specific alteration. But the great confidence which the Society has, especially of late years, placed in its more permanent officers, and the power which naturally accrues to them from the comparatively short tenure of office by the other Members of Council, appear to me to be points of which the Society should not lose sight. On the part of the officers I think it right to state that we are very sensible both of the honour which is thus done to us and of the responsibility which is thereby entailed, and that we hope never to discredit the one nor to abuse the other And having said so much, we are quite willing to leave the matter in the hands of the Society to be taken up whenever they see reason so to do.

It will be in the recollection of the Fellows that the position of the Royal Society in respect of the Government Fund of 4000*l*. per annum is different from that in relation to the Government Grant of 1000*l*. per annum In the latter case the sum is placed unreservedly in the hands of the Society for promoting scientific investigation, subject only to an annual report to the Treasury of the disposal of it; and, in administering it, the Society has in no case applied it to the personal remuneration of the applicant. In the former case the Society has been requested to advise the Science and Art Department as to the distribution of the grant, not only for the direct expenses of investigations, but also for personal remuneration for the time expended on them, whenever the circumstances and wishes of the applicant appeared to render this desirable. The responsibility of this advice lies with a Committee similar to that of the Government Grant, but with the addition of the presidents of certain learned bodies and societies, nominated for that purpose by the Government.

The recommendations made by the Committee each year are annually published in the *Proceedings*, so that the public will have had full information as to the distribution of the grant; while the Fellows have the opportunity of seeing the nature of applications made, and the extent to which it has been found practicable to meet them, as recorded in the minutes of the Council of the Society.

One of the points which is perhaps beset with the greatest difficulty is that of the so-called "personal" grants. On the one hand it has been argued that it is desirable to enable the man of small means to devote to research a part of his time which he could not otherwise afford to give; but, on the other, the question has been raised whether it be wise, even in the interests of science, to encourage any one not yet of independent income to interrupt the main business of his life. It is too often assumed that a profession or a business may be worked at half-speed, or may be laid down and taken up again, whenever we like. But this is not so, and a profession temporarily or even partially laid aside, may prove irrecoverable; and the temptation to diverge from the dull and laborious path of business may prove to have been a snare. Without proposing to exclude from possible aid in some shape or other those cases where personal assistance may be safely offered, it has been suggested that many such cases may be practically met by grants for the employment of an assistant, instead of grants to the applicant himself.

There is another fundamental difference between the position of the Government Grant of 1000*l*. per annum and the Government Fund of 4000*l*. per annum, which appears to me to be of material importance in the interests of science. The former is an absolute grant from the Treasury made to the Society for scientific purposes. It may be used wholly, or in part, during the year in which it is made, and the balance, if any, may be carried over by the Society to the next or even to succeeding years. The latter is a vote to the Science and Art Department, on the disposal of which the Society is consulted. Like all other similar votes, any unused balance reverts to the Treasury, and is to that extent lost to the purpose for which it was intended. I cannot help thinking that, if any such balances could be reserved and kept in hand, provision might be made for some larger purposes than those to which the fund has hitherto been devoted. And, even if having this end in view, the Committee should not see its way to recommend some of the smaller applications, it may be fairly questioned whether the smaller grants might not find a more appropriate place among those of the Donation Fund of this Society, or of the British Association, or among some of those separate funds which, through the liberality of individuals, are now growing up among the special societies.

I am glad to record the fact that, upon the recommendation of men of science, Her Majesty has been pleased to grant pensions on the Civil List to the widows of two of our late Fellows, viz., to Mrs. John Allan Broun and to Mrs Clifford.

Last year two volumes containing a collection of the late Prof Clifford's general lectures and essays were brought out. It is hoped that during the present winter a collection of his mathematical papers will be published. The contributions to science by the late Prof Rankin have recently been placed in the hands of the public While very sensible of the obligations under which the scientific world is placed by these posthumous publications, I cannot refrain from alluding to our obligations, even greater if possible, to those who during their lifetime are willing to re-issue their own scientific memoirs, and to give us thereby not only the convenience of ready access, but also the advantage of their own subsequent reflections on the subjects of which they have treated. And at this particular moment I desire to mention more particularly the mathematical and physical papers of our Senior Secretary, Prof. G. G. Stokes; and, while expressing our gratitude for the volume which has already appeared, I would express also our sincere hope that another instalment from the same source may shortly follow.

Among the subjects which at one period of the late session of Parliament engaged the attention of the Government was that of the law relating to vaccination, and a Bill was introduced intended to remove some of the practical difficulties in carrying out the existing law While fully admitting the difficulties in question, the remedy proposed appeared to trench so closely upon the application at least of a scientific principle, and at the same time to be so important in its practical aspect, that I ventured (although the Council was not sitting) to consult the Presidents of the Colleges of Physicians and of Surgeons, and that of the Medical Council, about addressing the Government on the subject. This resulted in a joint deputation to the President of the Local Government Board, in which I took part as President of the Royal Society. I reported this matter to the Council at their first meeting after the recess, and received their approbation The Bill in question was withdrawn

The Royal Commission on Accidents in Coal Mines, the appointment of which I mentioned in my address of last year, has been occupied principally in bringing together a body of valuable evidence on the causes and prevention of accidents in mines generally. The Commission has also visited a number of mines in which serious accidents by explosion have taken place, or in which certain phenomena connected with the occurrence of fire-damp were to be studied. They have also instituted a series of experiments on the behaviour of various safety lamps in mixtures of natural fire-damp and air. These experiments they are about to renew during the winter. They also contemplate carrying out experiments in blasting rock and coal by methods which will check the production of flame, and which are thereby calculated to obviate the danger of igniting fire-damp.

The report of the voyage of H.M.S. *Challenger*, to which the scientific world has been looking forward with so much interest, is now so far advanced that one volume of the "*Zoological Memoirs*" will appear immediately In addition to this a second volume may be expected within a year. The first volume of the whole work, "containing a short narrative of the voyage, with all necessary hydrographical details, an account of the appliances and methods of observation, a running

outline of the results of the different observations; and a chapter epitomising the general results of the voyage," together with the second volume containing the meteorological, magnetic, and hydrographic observations, will probably be published within the same period "The general report on the zoology of the expedition will consist of about fifty distinct memoirs, which will occupy from ten to twelve volumes." It has been arranged "to print the Zoological Reports as they are prepared, and to publish them as soon as a sufficient bulk of memoirs is ready to form a volume. Copies of each memoir may also be had separately, in order that working naturalists may have them in their hands at the earliest possible date." Two more volumes on the geology and petrology, and one on the general chemical and physical results, will probably complete the series. Into the details of the zoological results I am not competent to enter, but the greatest interest attaches to the fact that notwithstanding the pressure and absence of light, there is no depth limit to animal life.

As the Council of the Meteorological Office is nominated by the Council of the Royal Society, and as the Annual Report of the Office is submitted to the Royal Society, I think it right to mention a few points connected with the work of that department during the past year.

1. A method of recording the duration of bright sunshine by the charring of an object placed in the focus of a glass sphere, freely exposed to the rays of the sun, was devised by Mr. J. F. Campbell of Islay in 1856, and instruments, being modified forms of that originally proposed, have been employed for some time at Greenwich, at Kew, and at a few private observatories. Certain difficulties in adjusting the paper about to be charred to the path of the burning spot, which had hitherto prevented the adoption of Mr. Campbell's invention as a part of the ordinary equipment of a meteorological observing station, have been at last successfully overcome by an arrangement designed by Prof Stokes; and thirty stations in the British Isles have now been supplied with instruments of the pattern proposed by him We may thus hope to obtain in future a sufficient record of a meteorological element, which is of primary importance in its relations to agricul ure, and to the public health, but which has hitherto been very imperfectly registered

2 The climatology of the Arctic regions, in addition to its importance as a part of the general physics of the globe, possesses a special interest in connection with geographical exploration. As a contribution to our knowledge of this subject, the Meteorological Office has entrusted to Mr. R Strachan the task of bringing together, and discussing on an uniform plan, the results of the observations taken at intervals during the last sixty years, in the region extending from the meridian of 45° W to that of 120° W, and from the parallel of 60° to that of 80°, either at land stations or at the winter quarters of British and American expeditions A considerable portion of this discussion has been already published, the remainder may be expected in the course of next year.

3 Another publication of the Meteorological Office may be mentioned as serving to mark the advance in meteorological theory, which has been achieved during the last fifteen years The old "Barometer Manual and Weather Guide" of the Board of Trade has been replaced, so far as it relates to the weather of the British Isles, by a work entitled "Aids to the Study and Forecast of Weather," prepared under the direction of the Meteorological Office by the Rev W. Clement Ley Though some of the views put forward in the later work may, perhaps, be regarded as not sufficiently established by observation, yet a comparison of the two works cannot fail to leave upon the reader's mind the impression that in the interval between their respective dates of publication, some real progress has been made in meteorology. Perhaps this is most conspicuous in the enlarged ideas that are now entertained concerning the conditions upon which the changes of weather depend. Local weather was first discovered to be contingent upon travelling areas of disturbance, each of which averaged many hundreds of miles in diameter, while, at the present time, the relation of these areas to one another, as parts of a single terrestrial system, has become a prominent topic of inquiry. If meteorology has thus been, to a certain extent, rescued from the ever-accumulating choas of numerical tabulations, which threatened to engulf the whole science, the improvement is mainly due to the development in recent times of the synoptic study of weather over large regions of the earth's surface, to which so great an impetus has been given by the extended facilities of telegraphic communication.

4. Balloon ascents, with a view to military purposes, are now systematically carried on under the direction of the War Office; and the endeavour has been made to take advantage of these ascents for observations of the thickness of the aerial current which causes our winds, and of the peculiarities of the currents above it in the upper strata of the atmosphere The military authorities have offered their co-operation in the most cordial manner; but the attention of an aeronaut is often so much engrossed by the operations necessary for working his balloon, that he has but little leisure for taking systematic records Nevertheless, observations of considerable interest have already been obtained, relating especially to the velocity and direction of the upper air currents, and there can be no doubt that a continuance of such observations affords the best prospect at present open to us of adding to the very scanty knowledge which we possess of the movements of the atmosphere, even at a moderate height above the earth's surface.

Among the various duties which the President of the Royal Society is called upon to fulfil, there are those of a Trustee of the British Museum, and, as an operation of great importance to science, namely the removal of the natural history collections to the new building at South Kensington, is now going on, the Fellows may be interested to hear what progress has been made in the work

The plans for the new building were approved as long ago as April, 1868 but the works were not commenced until the early part of 1873. Their progress was retarded by difficulties in the supply of the terra cotta with which the building is faced within and without, and in which the mouldings of arches and other ornamental features are executed.

The building was finally handed over to the Trustees in the month of June of the present year It contains cases for three only of the departments for which it is intended, namely, Mineralogy, Geology, and Botany, the necessary funds for the Zoological Department not having yet been voted As the latter collections are equal in bulk to the other three collectively, it follows that only half the new building can at present be actually occupied. The removal of the collections for which cases had been provided, commenced in the last week of July, and was virtually completed by the end of September.

Geology, which was very inadequately displayed in the old building, is now more commodiously accommodated. It now occupies a gallery 280 feet in length by 52 in breadth, forming the ground floor of the east wing of the new museum, together with eight other galleries covering an area of 200 × 170 feet at the back, and admirably adapted for the exhibition of the specimens One of these galleries will be devoted to the illustration of stratification

The principal part of the Minerals has been moved and replaced in the cases in which they were arranged in the old building The collection now occupies the first floor of the east wing of the new museum, and the space devoted to it is 280 × 50 feet in area. It is already arranged for exhibition.

The Botanical collections are placed in the gallery over the minerals, where the space for exhibition and the conveniences for study are much greater than in their old quarters

The construction of the cases for the Zoological specimens, and the ultimate removal of these collections, must depend upon the amount of the Parliamentary vote for the purpose, but under the most favourable conditions it can hardly be hoped that this department can be open to the public or to students for two years from the present time

The "Index Museum," designed by Professor Owen, will form a prominent feature in the new museum The object of it, in his words, is "to show the type characters of the principal groups of organised beings," and "to convey to the great majority of visitors, who are not naturalists, as much information and general notions of its aim as the hall they will first enter and survey could be made to afford."

One of the principal difficulties attending the transfer of the Natural History Departments to a separate building consists in the provision of books for the use of the keepers and their staff, as well as for students who may visit the museum Hitherto the separate collections of books, known as departmental libraries, supplemented as occasion might require from the main library of the museum, have sufficed for all purposes. But now, when the departmental libraries have to stand by themselves, it is impracticable to carry on even the current work of arrangement without additional resources. For an adequate supply of the necessary works a very large outlay would be required, sup-

posing that the works were in the market. But many of them are out of print and have become scarce, and a large grant of public money would perhaps raise the market price almost in proportion to its magnitude. This being so, it has been thought best, on the whole, by the Government to make an annual grant to be expended from time to time as favourable opportunities for purchase may offer If it should prove possible, and on other grounds desirable, to allow the Banks' Library to follow the collections with which it has always been practically connected, the wants of the Natural History Departments would (so far as books up to the date of its bequeathment are concerned) be in a great measure supplied.

Another of the duties which falls officially on your President is to take part in the organisation of technical education as promoted by the City and Guilds of London Institute, which is now incorporated under the Companies Acts, 1862-80, as a registered association, and of which the Presidents of the Royal Society, the Chemical Society, the Institute of Civil Engineers, and the Chairman of the Council of the Society of Arts, are members. In the Memorandum and Articles of Association of the Institute, its objects are fully set forth. They may be summarised under the following heads:—

1. The establishment of a central technical institution for instruction in the application of science and art to productive industry.

2. The establishment of trade and technical schools in London and in the country.

3. The development of technical education by means of examinations held at the Central Institution, or at other places.

4. To assist by means of grants existing institutions in which technical education is being promoted.

5 To accept gifts, bequests, and endowments for the purposes of the Institute.

The Institute is supported by subscriptions from sixteen of the City Companies, of which the largest contributors are the Mercers, Drapers, Fishmongers, Goldsmiths, and Clothworkers.

The Institute has been in active operation not much more than a year, and during the last six months the work of the Institute has developed considerably in each of its several departments. These may be considered under the following heads:—

1 Technical Instruction.

2. Examinations in Technology.

3. Asssistance to other Institutions.

1. Since November last courses of lectures and laboratory instruction have been given in the temporary class-rooms of the Institute, at the Cowper Street Schools, under the direction of Prof Armstrong, F R S., and of Prof Ayrton The subjects of instruction have included Inorganic and Organic Chemistry, with special reference to their industrial applications, Fuel, Electro-depositions of Metals, and Photographic Chemistry; General Physics, Steam, Electrical Engineering, Electrical Instrument Making, Electric Lighting, Weighing Appliances, and Motor Machinery

During the term ending July last the number of tickets issued to students, most of whom belonged to the artisan class, exceeded three hundred A considerable accession of students is expected as soon as the building in Tabernacle Row, the plans of which are already settled, shall be erected. This building, which is estimated to cost £20,000*l*., will provide accommodation for schools of Technical Physics, Technical Chemistry and Applied Mechanics Many of the day students at these classes are pupils of the Cowper Street Schools, and it is expected that, by adapting the course of technical instruction to be given in the College to the wants of these boys, a very complete technical school for the children of artisans will have been established.

The evening lectures and laboratory instruction, which are more advanced and more special, are attended very largely by external students, for whom the present temporary accommodation is already too limited.

At Kensington, schools have been established in which practical instruction is given in various art subjects, such as Painting and Drawing, Modelling, Designing, and Wood Engraving. These schools are attended by both sexes, and are under the immediate direction of Mr. Sparkes The numbers in attendance last term were as follows:—

Wood Engraving . . .	8 Students,	3 Men,	5 Women.
Modelling	28 ,,	26 ,,	2 ,,
Drawing and Painting from Life	42 ,,	19 ,,	23 ,,
Designing	33 ,,	3 ,,	30 ,,

The Central Institution for instruction in the application of the higher branches of science to industrial pursuits is about to be erected on a plot of ground in Exhibition Road, granted by the Commissioners of 1851. The construction of this building, which, when completed, will cost 50,000*l*., has been entrusted to Mr. Alfred Waterhouse, who is now engaged in the preparation of plans.

2. In the year 1879, the examinations in Technology, which had been initiated by the Society of Arts, were transferred to this Institute. Various changes where introduced into the regulations New subjects were added, and in order to stimulate the teaching of Technology throughout the country, the principle of payment to teachers on the results of the examinations was adopted The encouragement thus afforded to teachers gave a great impetus to the formation of classes throughout the country in technological subjects. Last year the number of candidates for examination was 202, while at the recent examination, held in May, 816 candidates presented themselves, of whom 515 satisfied the Examiners During the last few months the number of classes throughout the country, in which technical instruction is being given, has considerably increased, and, judging from the returns already received, there is reason to believe that the number of candidates, who will present themselves for examination next May will be much greater than in either of the preceding years The new programme, which is just issued, contains a syllabus of each subject of examination, and every effort has been made, short of testing the candidates' practical skill, to make the examinations as efficient as possible. To obtain the Institute's full certificate, each candidate is required to give evidence of having obtained some preliminary scientific knowledge

3. In order to take advantage of efforts that are already being made to advance technical education, the Institute has given sums of money for specific objects to several institutions in which technical instruction is provided The schools, colleges, and other bodies which have received grants from this Institute, are University College and King's College, London, the School of Art, Wood Carving, and Mining Association of Devon and Cornwall, the Nottingham Trade and Science Schools, the Artisans' Institute, the Birkbeck Institute, the Lancashire and Cheshire Union, and the Horological Institute.

The Artisans' Institute gives practical instruction in several of the humbler crafts in which artisans are engaged, such as carpentry, zinc work, and plumbers' work; and corresponds, therefore, to some slight extent with the apprenticeship schools of the Continent, from which, however, it differs in many important particulars. A similar experiment is being tried at the Horological Institute, where, at the expense of the Guilds, classes have been organised, in which apprentices receive practical instruction in the various branches of the watch-making trade.

It is found that the demand for technical instruction in London and throughout the provinces is very great, and the efforts that have been so far made by the City and Guilds of London Institute have been received with considerable satisfaction by artisans and others engaged in industrial pursuits, and promise, when further extended, to be of the utmost service in the development of technical education in this country Turning now more particularly to the progress and the applications of science, I venture to make mention of a few topics which have come under my own observation.

(To be continued.)

OUR ASTRONOMICAL COLUMN

LUNAR ECLIPSES, 1880-84.—The total eclipse of the moon is only partly visible in this country, the middle occurring at 3h. 39m. Greenwich time, and the moon not rising until seven minutes later, the end of the total phase takes place at 4h. 24m., and the last contact with the earth's shadow at 5h. 33m In Australia the whole eclipse may be witnessed to advantage On December 5, 1881, there will occur an almost total eclipse (magnitude 0 97), again only partly visible here; the first contact with the shadow at 3h. 28m, and the moon rising at 3h 50m.; greatest phase at 5h. 8m In 1882 there will be no lunar eclipse. On October 16, 1883, a partial eclipse is barely visible here, first contact with the shadow at 5h. 59m. a.m, the moon setting at 6h 25m. The next favourably-circumstanced lunar eclipse, as regards observation in this country, will take place on the evening of October 4, 1884; first contact with shadow at 8h. 15m, beginning of total phase at 9h. 16m., middle of the eclipse

at 10h. 2m., ending of total phase at 10h. 48m, and last contact with shadow at 11h. 49m.

A PROBABLE VARIABLE STAR.—On November 25 Swift's comet was compared with the star No 4339 of Lalande, by Mr Talmage at Mr Barclay's Observatory, Leyton, the magnitude of the star being estimated 8, as it was also by Lalande. Argelander, in the *Durchmusterung*, gives it 6·4, and Heis made it a naked eye star (6·7), but erroneously identifies it with Lalande 4359 It escaped observation in the Bonn Zones, and may be worth occasional examination as likely to prove an addition to our variable star list

FAYE'S COMET.—In the *Berliner astronomisches Jahrbuch* for 1882, Prof. Axel Moller, of Lund, has given an ephemeris of Faye's comet extending to the end of March next. On comparing the theoretical intensity of light appended to the ephemeris with that corresponding to particular epochs in other appearances, it will be found that there is a probability of observing the comet for some weeks from this time without difficulty if the larger instruments be employed. Thus at the beginning of January the calculated degree of brightness is more than twice that appertaining to the dates when the comet was first and last observed with the Northumberland telescope at Cambridge, during the return of 1850 51, and the geocentric position is favourable for observation, a month later the intensity of light is still equal to that at the time of the first observation with the Copenhagen refractor in 1865, and even at the close of Prof Axel-Moller's ephemeris it is equal to that at the first and last Cambridge observations above alluded to, the comet's place, however, will then be drawing into the evening twilight We have already remarked that the magnitude of the planetary perturbations of the comet's motion during the revolution 1873-1881 is greater than in any other revolution since the comet's discovery in 1843, and the success which has again attended his prediction of its apparent track in the heavens must have excited the admiration of those who have any experience or knowledge of such investigations, and the immense amount of skilled application involved in them

SWIFT'S COMET.—The following elements depend upon Mr Chandler's observation on October 25, one at Strassburg on November 9, and a third at Mr J. G Barclay's Observatory, Leyton, on November 25 —

Perihelion passage 1880, November 8 3691 Greenwich M T

	° ′
Longitude of perihelion	42 15 2
,, ascending node	294 46 6
Inclination	7 21 3
Log perihelion distance	0 04188

Motion—direct

The close resemblance to the orbit of the third comet of 1869, it will be seen, is maintained. The elements give these positions for Greenwich midnight —

	R A	Decl	Log distance from Earth	Log distance from Sun	[illegible]
	h m	° ′			
Dec 2	3 44 1	+50 57	9·3188	0·0680	16 8
3	3 53 6	50 10			
4	4 2 5	49 21	9·3366	0·0721	15 2
5	4 10 7	48 32			
6	4 18 5	47 41	9·3556	0 0765	13 7
7	4 25 6	46 50			
8	4 32 3	+45 59	9 3756	0 0811	12 2

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—No further regulations have been issued by the University Commissioners for the Professoriate. Opinion is much divided in the University itself as to the operation of the new rules. There have been several memorials to the Commissioners got up, some praying that no alterations be made, others approving the new Councils of the Faculties. There seems to be a general feeling against insisting on the professors examining their classes every term, and against making attendance at their lectures compulsory The Councils of Faculties are regarded by many with favour as a means of bringing the tutors and lecturers of the various colleges who are engaged in teaching the same branch of learning into closer relationship, and enabling them better to divide the work among them.

At Balliol College an extra scholarship on the Blakenbury Foundation has been awarded to Mr. A D Hall of Manchester Grammar School, for Natural Science.

A MEETING of the Convocation of Victoria University was held at Owens College, Manchester, on Friday, Dr Greenwood presiding. A resolution was received from the Associates of the College expressing their gratification at the creation of the University, and pledging themselves to perform their part in maintaining the welfare, dignity, and fame of the University, and promoting its objects Standing orders for the regulation of the proceedings of Convocation were adopted, and the Rev C. J Poynting was appointed clerk.

THE recently-presented budget of Prussia shows that, despite the financial straits of the kingdom, no considerations of economy are allowed to hamper the growth of its scientific and educational system First on the list come the nine universities with an allotment of 7,050,000 marks (352,500*l*.) Berlin receives the lion's share, 1,378,348 marks, an increase of about 37,000 marks on its last annual subvention. Bonn and Konigsberg each have 740,000 marks, Breslau 600,000, Kiel 404,000, Marburg and Halle each 430,000, Gottingen 201,000, and Greifswald 136,000 Of the above mentioned sum about 1,306,000 marks are appropriated for extraordinary expenses in connection with the construction of university buildings, and of this amount Berlin absorbs over one half, viz, 766,000 marks The other chief items in the Budget of Public Instruction are Gymnasia and Realschulen, 5,000,000 marks, primary schools, 14,500,000, orphanages, schools for the blind, deaf and dumb, &c, 300,000; technical schools, and for the general furtherance of science and art, 3,000,000 marks.

THE number of pupils of Lycées and Colleges in the French Republic is 87,000 (46,500 for Lycées and 40,500 for Colleges). Last year it was only 84,700 These establishments may be considered as analogous to the English grammar schools.

SCIENTIFIC SERIALS

Journal of the Franklin Institute, November —The metric system is it wise to introduce it into our machine-shops? by C Sellers —The weakening of steam boilers by cutting holes in the shell for domes and necks, by W. B. Le Van —Observations in Brazil, by W M Roberts

Rivista Scientifico-Industriale, October 31.—*Résumé* of solar observations at Palermo Observatory in the third quarter of 1880, by Prof Ricco.—Experimental researches on the action of light on transpiration of plants, by Dr. Comes —Dynamometric break with circulation of water, by Prof. Ricco

Journal de Physique, November —On the combination of phosphuretted hydrogen with hydrochloric acid, by M. Ogier.—An amplifying barometer, by M Debrun

SOCIETIES AND ACADEMIES

LONDON

Linnean Society, November 18.—Robt McLachlan, F.R S, in the chair.—Dr. Geo. E Dobson exhibited a remarkable parasitic worm from the intestine of *Megaderma frons*, from the Gold Coast It appears allied to *Pterygodermatites plagiostoma*, Wedl, from the Long eared Hedgehog, though on first hasty examination he (Dr Dobson) had been disposed to regard it as a new genus, *Metabdella* Dr. McDonald further drew attention to its peculiar anatomical structure and relationships Dr. Cobbold agreed to the importance of the observations as verifying previous discoveries, with addition of novel structural details He considered the worm as identical with the *Ophiostomum* of Rudolphi and Willemoes Suhm, with *Pterygodermatites* of Wedl, and with *Rictularia* of Froelich, and he regarded it as an aberrant member of the Ophiostomidæ, whereas Wedl thought it came nearest the Cheiracanthidea.—Dr Cobbold also exhibited specimens of *Distoma crassum*, Busk (previously in 1875 shown to the Society), from a Chinese missionary who, on return to China with his wife and daughter, were again all attacked by the parasite, and obliged to return to England.—A paper was read on a proliferous condition of *Verbascum nigrum*, by the Rev. G. Henslow. The upper part was very diffuse with leafy axes produced from the centres of the flowers, while the lower part had flowers with very large ovaries adherent within to arrested proliferous branches. These differences may be attributed to the general tendency of

the sap to run to the extremities and thus cause an excess of development above with simultaneous arrested condition below.—A paper on the classification of the Gasteropoda (part 2) was read by Dr. J. Dennis McDonald. In this communication the author gives further data in support of his mode of arranging the group dependent on anatomical characters.—"Novitates Capenses" was the title of a paper by Messrs. P. MacOwan and H. Bolus, in which, among other novelties described of South African plants, were *Ranunculus Baurii*, *Ericinella passerinoides*, *Orthosiphon ambiguens*, and *Herpolirion capensis*, the last a representative of a form hitherto known only from Australia.—A communication from the Rev. M. J. Berkeley, on Australian fungi (part 2), principally received from Baron F. von Muller, was taken as read.—Lieut. Col H. Godwin-Austin was elected a Fellow of the Society.

Entomological Society, November 3.—Sir Jno. Lubbock, Bart., vice-president, in the chair —Mr. E. Meyrick of Hungerford, Wilts, and Capt Thos. Broun of Auckland, New Zealand, were elected as Ordinary Members, and Dr. J. E. Brandt, president of the Russian Entomological Society, was elected as a Foreign Member of the Society.—Mr. Waterhouse exhibited, on behalf of Mr. Sydney Olliffe, a pair of dwarfed specimens of *Epione vespertaria*, taken at Arundel —Mr. McLachlan exhibited some curious galls on a broad-leaved *Eucalyptus* from Australia, which were stated to be made by a lepidopterous larva, and also mentioned that in a letter he had received from Mr. Rutherford, dated from Camaroons, West Africa, the writer stated that he had taken *Papilio merope* and *Papilio cenea* in copula. Mr. Trimen doubted that the butterfly referred to by Mr. Rutherford was *P. cenea*, Stoll, which, to the best of his knowledge, was a form of the female confined to South Africa, and was more probably either *Hippocoon*, Fab., or one of the other prevalent West African forms.—Prof. Westwood exhibited a globular gall on the surface of a sallow leaf made by a species of *Tenthredinidæ*, and also a dipterous larva (Syrphus) found closely adhering to the stem of a pelargonium —Mr Kirby exhibited a remarkable variety of *Epunda lutulenta*, and also a remarkable form of *Apatura*, stated to have been taken by Mr. Ralfe in Pinner Wood.—Sir Jno Lubbock exhibited some interesting larvæ which Mr. Culvert had forwarded to him from the Troad through Sir Joseph Hooker He stated that these larvæ had recently appeared there in great numbers, and were likely to prove most useful, as they fed on the eggs of locusts. These larvæ were probably coleopterous, and Sir Jno Lubbock suggested that if the species does not exist in Cyprus it might be worth while to introduce it there —Mr. Trimen exhibited a wingless female specimen of the Hymenoptera, which he had strong grounds for believing was the female of the well-known *Dorylus helvolus*, Linn —Mr Trimen also exhibited six cases fabricated by a South African lepidopterous larva, of which the outer covering consisted of particles of sand and fragments of stone, which gave them a most peculiar aspect, resembling in general appearance a myriapod.—Sir Sydney Saunders read a paper on the habits and affinities of the hymenopterous genus *Scleroderma*, with descriptions of new species —Mr Edward Saunders read a paper entitled a synopsis of British *Heterogyna* and fossorial *Hymenoptera*.—Prof. Westwood read a paper containing descriptions of new species of exotic diptera, with a supplement containing descriptions of species formerly described by the author in somewhat inaccessible publications.

PARIS

Academy of Sciences, November 15.—M. Edm. Becquerel in the chair.—Researches in isomerism, benzine, and dipropargyl, by MM Berthelot and Ogier.—On papaine; new contribution to the study of soluble ferments, by M. Wurtz In one experiment 0·05 gr of papaine fluidified about two thousand times its weight of moist fibrine. It seems that it begins by fixing on the fibrine, and the insoluble product gives, by action of water, soluble products of hydratation of fibrine, while the ferment, becoming free again, may act on a new portion of fibrine. The action is thus related to that of chemical agents, *e.g* sulphuric acid.—Enrichment of plumbic earths by a current of compressed air, by M. Delesse. The apparatus, called *trieur à soufflet*, effects a sorting of pulverulent matters, which cannot be separated by water. Earths of very fine grain cannot well be treated with it, and unfortunately it is they that contain most lead. The lead-dust produced is unhealthy for the workmen.—Observations of M de Quatrefages on the Marquis de Nadaillac's work, "Les premiers Hommes et les Temps préhistoriques." M. de Quatrefages thinks that man probably existed in Portugal in the Tertiary epoch.—Observations on the publication of Dr. Guérin's works, by M. de Quatrefages —On the arrangement of the cervical vertebræ in the Chelonians, by M. Vaillant.—Experimental researches on the heat of man during movement, by M. Bonnal. *Inter alia*, all muscular exercise raises the rectal temperature. The increase is not directly related either to duration of the exercise or to apparent fatigue. The altitude, state of the atmosphere, energy of movements, and nature of clothing affect the increase. All rapid exercise diminishes the peripheral temperature (in mouth, armpit, or groin) The rectal heat may reach 39 5°. In rapid climbing it is in the first half hour that the rectal temperature is most raised, it may then become stationary or fall In general, a rigorous application of the laws of mechanics to the human system is not warranted.—Studies on the habits of phylloxera during August to November 1880, by M. Fabre. The young insects showed (in the author's experiments) a strong liking for light. The present year seems very unfavourable to the parasite —On some linear differential equations, by M. Brioschi —On the equilibrium of flexible and inextensible surfaces, by M. Lecornu.—On the compressibility of oxygen and the action of this gas on mercury when put in contact with it, by M. Amagat. Oxygen and mercury (pure and dry) he found to remain indefinitely long in contact without absorption. He operated at 50° and 100°, and with pressures from 110 to 420 atm The compressibility of oxygen follows the laws he gave in his memoir of August 30. MM. Chevreul and Dumas made remarks on the subject —On the liquefaction of ozone in presence of carbonic acid, and on its colour in the liquid state, by MM Hautefeuille and Chappuis. Gradual compression of a mixture of ozonised oxygen and carbonic acid at − 23° gives a blue liquid of the same shade as the gas above. The products of decomposition of carbonic acid by the effluve are proved (by the blue colour on compressing) to contain a large proportion of ozone.—On malleable iron, by M Forquignon. It seems to be intermediate between steel and grey pig-iron, differing from the latter by the special nature of its amorphous graphite and its greater tenacity; from steel, by its small elongations and its large proportion of graphite.—On the presence of phosphorus in the rocks of Brittany, by M. Lechartier.—On the composition of petroleums of the Caucasus, by MM Schutzenberger and Ionine —On the temperatures of inflammation of gaseous mixtures, by MM Mallard and Le Chatelier. Among other results, mixtures of protocarburetted hydrogen not only enter into slow combustion, but, when submitted to a certain temperature, may be inflamed after a variable time (which is longer the lower the temperature).—On the secondary wave of muscle, by M. Richet A second contraction occurs, without fresh stimulation —On the contagion of boils, by M. Trastour —On the use of boring machines without use of explosive matter, by M Biver The advantages of Mr. Brunton's system are indicated.

CONTENTS

THURSDAY, DECEMBER 9, 1880

BRITISH EARTHQUAKES

ON Sunday evening last week (28th Nov.) the northern parts of the British Isles were slightly shaken by an earthquake. The recent disastrous earthquake shocks in Croatia have called renewed attention to this still mysterious geological phenomenon, and now, while the subject is still fresh and under discussion, a milder visitation of the same nature reminds us that our islands are not wholly exempt from their share in the pulsations of the terrestrial crust. Save the vague and inexact newspaper paragraphs which chronicle the impressions of different observers, we have no information as to the direction of propagation of the earthquake wave of last week, its duration, relative intensity, and angle of emergence at different localities. It appears to have been one of the usual type of earth-tremors experienced in this country, and to have affected the region which, during the present century at least, has been most subject to such movements. It is reported as having been felt at many points in the central valley of Scotland and in the north-east of Ireland, also along the west coast as far north as the further end of the Long Island. Its effects appear to have been most marked over the area occupied by the crystalline schists. In Bute the house-bells rang. At Oban a portion of the plaster was detached from the ceiling of the parish church during the service of the Sunday-school. At Inverary also some plaster was loosened, and a sensation of nausea and giddiness is even said to have been experienced. At Blair Athole the oil in the table-lamps was thrown into undulations, which rose over half an inch up the side of the glass. Over the Lowland belt the effects were less perceptible, though they are alleged to have been distinctly felt as far as Edinburgh. By some observers the duration of the shock was estimated at two, by others at ten seconds. In some places the movement was thought to be from the north-west, in others, from the south-west. One of the phenomena duly chronicled in most of the narratives is the jingling and creaking made by crockery and furniture. Such is the usual meagre kind of detail out of which an explanation of the cause of earth quake movements in Britain is in truth hardly possible.

If we look back into the history of the subject numerous references to earthquake shocks will be found in the annals of the last seven or eight centuries in this country. And if the chroniclers are to be believed, some of these were of exceptional severity. According to the list compiled by Sir John Prestwich, shocks seem to have been specially numerous and severe in the twelfth century. Thus on the 2nd of August, 1134, England was shaken by an earthquake just at the very time that Henry I. was about to take ship for Normandy; "flames of fire burst forth with great violence out of certain riffs of the earth." On another occasion, in the same century, the bed of the Thames was laid bare at London. We read, too, of churches and other buildings having been from time to time thrown down, and of open rents having been left in the ground after the passage of the shock.

In the contemporary records of these phenomena the geologist vainly searches for particulars that may serve to elucidate their origin. He finds much that is doubtfully correct, not a little that is obviously fabulous. Naturally the events were considered merely in their relations to the human population of the country, and those aspects of them were noted that bore special interest in that respect. Most frequently they were regarded in the light of divine judgments, and were connected with some real or imputed delinquency on the part of the inhabitants. We read, for instance, that on the 8th November, 1608, a rather smart shock of earthquake passed over Scotland. In the southern counties it was looked upon as a result of "the extraordinar drouth in the summer and winter before." But the more orthodox worthies in the farther north took a higher view of it. The kirk-session of Aberdeen met, and accepting the earthquake as "a document that God is angry against this land and against this city in particular for the manifold sins of the people," appointed a solemn fast for next day. On further reflection they came to recognise one sin in particular as having doubtless called down the judgment. For more than 150 years, in virtue of a bull granted by Pope Nicolas V., the proprietors on the banks of the River Dee had been accustomed to fish salmon on Sunday. These Sabbath-breakers were accordingly now summoned before the session and rebuked. Some of them agreed to give up their custom, but "some plainly refusit anyway to forbear." Again on 20th October, 1580, an earthquake occurred that particularly affected the house of the Master of Gray. The boy king, James VI. asking Fergusson, the minister of Dunfermline, "What he thought it could mean, that that house alone should shake and totter," was grimly answered by the divine "Sir, why should not the devil rock his awn bairns?"

Doubtless many of the events chronicled in former centuries as earthquakes may not have been of that nature. Landslips and violent storms would account for some of the phenomena recorded. In looking over the lists of reputed earthquakes we cannot fail to notice that some districts of the country have been specially liable to the visitation. One of these has been the south-west of England, embracing the lower basin of the Severn with Somerset, Gloucester, Worcester, Cornwall, and the adjoining counties. Another notable area for a hundred years past has been the southern highlands of Perthshire.

After making every allowance for the vast multiplication of the means of recording passing events afforded by the extension of newspapers and the consequent increasing minuteness of detail in our domestic annals, there seems no reason to doubt that the number of earthquake shocks has increased during the present century, though possibly none may have reached the severity of some recorded in earlier periods. During the four years subsequent to September, 1839, upwards of 200 shocks were felt in Perthshire, some of which extended over nearly the whole of Scotland.

In searching for a possible solution of the problem presented by these terrestrial commotions one or two circumstances should be specially considered. In the great majority of cases where details of any kind have been preserved of the nature of the earthquakes, reference is made to noises that immediately preceded the actual

shock In not a few instances these seem to have been the most alarming part of the phenomena. They are variously likened to the sound of a rushing wind, the roll of waggons, the muttering of thunder, or the rattle of cannon With these aërial vibrations there are also recorded sounds as of a sudden snap or blow, or explosion in the earth underneath Another feature of the earthquake-register is the persistence with which a relation is believed to exist between the commotion in the ground and the state of the atmosphere above In some cases, indeed, the barometer is said to have suddenly fallen, and then to have risen after the shock had passed Warm, damp, moist weather, heavy rain, thunder, strange electrical discharges, fire-balls, and other meteoric phenomena are chronicled as the concomitants of earthquakes It may be said, of course, that the occurrence of these events together is only of the nature of a coincidence, and cannot conceivably be anything else There can be no doubt, however, that in Britain, as on the Continent, earthquakes have been more numerous in the winter than in the summer half of the year Of the fifty-nine earthquakes in Sir John Prestwich's list, as Prof Prestwich has pointed out, eleven occurred in winter, eleven in spring, seven in summer, and eight in autumn Out of 139 earthquakes recorded as having happened in Scotland up to September, 1839, eighty-nine occurred in the winter half of the year and fifty in the summer half We cannot suppose that any variation in the meteorological condition of the atmosphere can directly give rise to an earthquake Nevertheless it is conceivable that where the crust of the earth is in a condition of tension, rapid and extensive changes of atmospheric pressure may destroy an equilibrium that has previously been barely maintained The observed relation between a low barometer and the more copious escape of fire-damp within coal-mines may possibly be of wider application

It is evident, moreover, that the source of disturbance must be at no great depth from the surface This is shown by the markedly local character of the phenomena A shock of considerable violence which rends walls, overturns chimney-pots, rings bells, shakes furniture, and fills with alarm the inhabitants of a few parishes, but is quite unperceived in the districts around, cannot have a deep-seated origin. In looking at the districts specially liable to such visitations we notice in some degree a connection with geological structure The earthquake area in the south-west of England embraces within its borders the ranges of the Malvern and Mendip Hills, which, with the surrounding country, point to a long succession of geological disturbances, while the hot springs that still rise there furnish additional indications of a connection between the heated interior and the surface The most remarkable earthquake district in these islands at present is undoubtedly that of Comrie in Perthshire, where in the month of October, 1839, no fewer than sixty-six shocks were felt, the severest being perceived as far north as Dingwall, and as far south as Coldstream During the last forty years the British Association has appointed two Committees to investigate the nature of the shocks so frequently experienced there. But their labours cannot be said to have as yet thrown much light on the subject. They have erected seismometers of approved construction and sensitiveness, but in many cases shocks that have been distinctly perceptible to the inhabitants have not been registered by the instruments. Much speculation has been offered as to the cause that earth-tremors should be specially abundant in that district. Reference has been made by different observers to protrusions of granite and dykes of basalt which traverse the rocks, as if these igneous masses supplied a clue to the source of movement. But neither the granite bosses nor the dykes are specially conspicuous in the Comrie district On the contrary, they are there small in area and few in number compared with their occurrence in other tracts where earthquake shocks are rare A geological structure at Comrie, however, which so far as we are aware has not been dwelt upon in this connection, is the occurrence there of the great fracture by which the southern edge of the Scottish Highlands is bounded The Old Red Sandstone with its associated volcanic bands has been thrown on end against the crystalline schists Of the extent of the dislocation no precise measurements have yet been made; probably the amount of upthrow varies along the line At the north-eastern end of the fracture the sandstones and conglomerates have been placed on their ends for about two miles back from the fault. The line of dislocation can be traced across the island from sea to sea and across the island of Arran, whence it points for Ireland It is probably one of the largest, as it certainly is the longest, fracture within the British area On its north-western side lie the crumpled schists of the Highlands, on its south-eastern boundary are the dislocated, curved, and even inverted strata of the Old Red Sandstone. Two series of rocks of very different structure and elasticity are here brought abruptly together along a vertical or at least steeply inclined face, which must descend for several thousand feet from the surface So far therefore as geological structure can be supposed to govern the origin and effects of earthquakes there does not appear to be within these islands any line or district where terrestrial disturbances should be so readily felt as along the flanks of the Scottish Highlands Shocks coming from the Lowlands will recoil against the crystalline wall of the Highland schists, and be consequently more perceptible there than over the more homogeneous formations lying to the south Another area in which earthquakes have been frequently observed is that of the Great Glen This longest, straightest, and deepest of British valleys has from early geological times been a line of weakness

There seems every probability in the supposition that some at least of our earthquakes result from the sudden collapse of rocks that have been under great strain Their occurrence along lines of powerful fault suggests that the rocks on one or both sides of these dislocations are still subject to great tension, and that occasional relief is obtained by a snap which is powerful enough to generate an earthquake, though it gives rise to no change of level at the surface. When we reflect upon the constant strain on the terrestrial crust as it settles down upon the more rapidly contracting nucleus, we may be allowed to be grateful that earthquakes are not everywhere more numerous and destructive.

THE ENCYCLOPÆDIA BRITANNICA

The Encyclopædia Britannica. Ninth Edition Vols x and xi. (Edinburgh: A and C Black)

THESE two volumes of the *Encyclopædia Britannica* fully sustain the high character of the earlier volumes. The articles dealing with branches of physical and natural science are conspicuous by their high quality and number In geographical science this volume is particularly strong Dr. Rae contributes an article on "Greece," several specialists contribute the article on "Germany," and General Strachey of the Indian Civil Service has produced a very striking and valuable essay on the "Himalayas." Besides these there are shorter articles on "Greenland," "Grisons," "Guiana," the "Hawaiian Islands," and "Heligoland," all worthy of attention and replete with information. In medical science we note particularly the articles on "Gout," contributed by Dr Affleck, and on "Heart Diseases" by Dr. G. W Balfour In the department of natural history the articles are almost exclusively on subjects of a specific or technical character; Prof Newton writes on "Grouse," and Mr John Gibson on the "Hare" and the "Hippopotamus." Prof. Church contributes brief articles on "Hemp" and "Guano," and Dr. Trimen has a good descriptive paper on "Grasses." The article "Herbarium," contributed by Mr. E M Holmes, is a remarkably useful and practical handling of a subject on which most botanical writers have usually very little to say, and the summary of information as to the character of the principal herbaria in existence will be found acceptable for reference The contributions to the physical sciences are numerous and of great interest Dr Ball's article on "Gravitation" is at once simple and masterly. The article on "Harmonic Analysis" by the late Prof Clerk Maxwell is all too short, but admirable in its way Amongst technical subjects we may single out the articles on "Gunpowder" and "Gun-cotton" by Major Wardell and Prof Abel respectively, on "Heating" by Capt D. Galton, two long and very fully illustrated papers by Col. Maitland on "Gunmaking" and "Gunnery," and one on "Harbours" by Mr. T Stevenson, which is accompanied by several capital plates. Mr. J. Blyth contributes two valuable articles on the "Gyroscope" and on "Graduation." From the latter we miss one or two points that might well have been added. There is no account of the dividing-machine employed by Messrs Cooke and Sons of York in graduating the circles of the great Newall telescope, nor of the still more recent dividing engine constructed by the Waltham Watch Company The biographical articles are numerous and excellent. Those on the two "Herschels" are from the pen of Prof Pritchard. That on "Sir W Hamilton" is contributed by Miss E. Hamilton The biographical notice of "Sir W Rowan Hamilton" is by Prof. Tait, than whom no one is more competent to write of the great mathematician; though somehow we miss in this thoughtful and appreciative article the peculiar characteristics of Prof Tait's trenchant style We propose to notice at greater length the important articles on "Geometry," "Geology," and "Heat"

The editor did well, we think, when he intrusted the compilation of the article upon such an important subject as "Pure Geometry" to so accomplished a geometer as Prof. Henrici We can fancy what such an article would have been in the hands of the generality of English mathematicians trained at our conservative Universities, meek followers, for the most part, of one master "There is but one Geometry, and Euclid is its exponent." We ourselves entertain a very high regard for Euclid indeed our indebtedness to him for what ability we may have in geometrical science is as great as that of Cicero to Archias for eloquence, but we cannot help feeling that we might have had a far greater mastery over modern methods had our masters been acquainted with these methods themselves. "This book," says one who has recently left us, a consummate master of modern methods, "has been for nearly twenty-two centuries the encouragement and guide of scientific thought . The encouragement, for it contained a body of knowledge that was really known and could be relied on, and that, moreover, was growing in extent and application. . . the guide, for the aim of every scientific student of every subject was to bring his knowledge of that subject into a form as perfect as that which geometry had attained" In our author we have one who,

"Nullius addictus jurare in verba magistri,"

can ungrudgingly acknowledge the many good points of the old-world geometer, whilst, with keen-cutting scalpel, he boldly lays bare his numerous defects The present generation, perhaps, will not see Euclid superseded in our schools; but when his warmest defender makes him admit that his proofs might be abridged and improved, that alternative proofs may with advantage be appended to his, and that new problems and theorems might be interpolated, we may expect that a time will come, quickly if only the Universities would not handicap their favourite so heavily, when his order and numbering of propositions may be abolished, and his treatment of parallels shelved. In the meanwhile we must work in hope, and the article under notice will possibly pave the way for an improved mode of studying the science As is well known, Prof. Henrici has long been engaged in writing a Geometry to this work we must refer readers for his views on the subject. In the *book* we see him as the teacher, laying his foundations deep and strong and broad enough for the vast superstructure—all pure geometry—they have to bear in the *article*, he treats his subject at first rather as the historian and critic, though subsequently he takes up the *rôle* of teacher again ("use doth breed such a habit in a man"), and rapidly but most deftly sketches a beautiful outline—in parts filled in—of the "higher" geometry In a long, but far from tedious, sketch of sixty-four columns he treats pure geometry in two sections the first, in twenty-five and a half columns, gives an account of the Elementary, or Euclidian, Geometry the second is devoted to the Higher, or Projective, Geometry. In section I we have a running commentary on Euclid's text, which does at greater length, though somewhat in the same style, what De Morgan did some years since in the "Companion to the British Almanac" (1849) The axioms which lie at the basis of the subject are well discussed, and their foundation upon experience established it is pointed out that the connection between these axioms has only been shown "within the last twenty years

through the researches of Riemann and Helmholtz, although Grassmann had already published, in 1844, his classical but long-neglected 'Ausdehnungslehre.'" In this connexion we can merely refer to the admirable lecture by Clifford, "The Postulates of the Science of Space" There is a good statement of Euclid's assumptions, but we shall refer only to that which is made in I 4, thus enunciated by De Morgan "Any figure may be removed from place to place without alteration of form, and a plane figure may be turned round on the plane" This is employed by Prof Henrici, as it has been by many others, to prove I 5, with this difference, that he does it after Mr. Dodgson has made Euclid say there is "too much of the Irish Bull about it, and that it reminds one too vividly of the man who walked down his own throat, to deserve a place in a strictly philosophical treatise" But the difference between these two writers is a radical one, and is not confined to the above solitary instance. The treatment of Book I (the remarks on axiom xii. in connection with I. 28, 29 are valuable) calls for no special comment. In Book II. we have the propositions discussed symbolically and proved by the aid of laws investigated by Sir W Rowan Hamilton and Grassmann laws familiar to more advanced students, but which are here put in a manner within the grasp, we think, of junior students. The book is one, however, to which this class never take very kindly, and requires patience and illustration on the part of the teacher. We can, from the outline here given, guess how Prof. Henrici will treat this part of geometry in his forthcoming second volume. The remarks upon the Fourth Book conclude with a "few theorems not given by Euclid," but they are readily derived from (if not explicitly stated in) Euclid's constructions. Of Book V there is a careful sketch, and our author shows "Why the usual algebraical treatment of proportion is not really sound." (Here we may refer also to Mr A J Ellis's "Euclid's Conception of Ratio and Proportion" in his "Algebra identified with Geometry," and in a simpler form in a lecture at the College of Preceptors) Books VI., XI, XII need not delay us We come now to the Projective Geometry, which we should much like to see reproduced in pamphlet form for use in colleges or schools. We notice Prof. Henrici states, "In Euclid's *Elements* almost all] propositions refer to the *magnitude* of lines, angles, areas, or volumes, and therefore to measurement." This, too, is our own view, and we presume it is what Mr Wilson intended when he says "Every theorem may be shown to be a means of indirectly measuring some magnitude", whether it be so or not, at any rate Mr. Dodgson cannot impugn the Professor's more guarded statement Those properties of figures which do not alter by projection are projective properties: there is a slight omission in the illustrations given, an exception should, we think, have been made in the case when the plane of projection is perpendicular to the plane upon which the quadrilateral, or circle, or other figure is projected. The points of difference between the two sciences are well put. "In Euclid each proposition stands by itself; its connection with others is never indicated, the leading ideas contained in its proof are not stated; general principles do not exist. In the modern methods, on the other hand, the greatest importance is attached to the leading thoughts which pervade the whole; and general principles, which bring whole groups of theorems under one aspect, are given rather than separate propositions. The whole tendency is to generalisation" Euclid, it is open to remark, throughout his work, avoids the *infinite*, whereas the modern geometry, like a good Samaritan, takes the most tender care of it. The systems adopted by Prof Henrici are principally the methods of projection and correspondence—as handled by Von Staudt in the "Geometrie der Lage," and by Grassman in his above-cited work. We should like to analyse this sketch in detail, but we must forbear For curves of two dimensions it is quite too delicious for us to mar it by such scant and imperfect treatment as we could here give it, and we must content ourselves with giving the heads of the several sub-sections After the statement of definitions and preliminary explanations, we have segments of a line, projection and cross-ratios (Clifford's name for the anharmonic ratios of Chasles), correspondence, curves and cones of second order or second class, pole and polar, diameters and axes of conics, involution, involution determined by a conic on a line—foci, pencil of conics The conclusion of the essay on the conics is that we arrive at the definitions from which our English text-books usually start. So the mode of treatment will be seen to be novel to the majority of English students The concluding sections (six columns) on ruled quadric surfaces, but more especially on twisted cubics, seem to us to bear on their faces tokens of having been somewhat hurriedly written, so are not quite up to the high standard of the previous work At the close Prof Henrici refers his readers to Reye's "Geometrie der Lage" for "a more exhaustive treatment of the subject." "Scarcely any use has been made of algebra, and it would have been even possible to avoid this little, as is done by Reye." Prof. Clerk Maxwell, in a note to us, commended, in his own quaint way, this work of Reye A short list of references is appended.

We could have wished that the "Analytical Geometry" had also been intrusted to Prof Henrici, more especially that we might have seen how he would have connected the two together, and also that we might have had the subject discussed from a Continental point of view. We have sufficiently comprehensive and good treatises already by English writers, some of which are adorned with much of Prof. Cayley's work, and we feel, too, that had our author had *carte blanche* for space, he would have done his work well, whereas in attempting to pack much matter into a small space we think he has assumed much which is not familiar to some, and yet at the same time which is elementary to others who are advanced students. Nor does the article, to our mind, thoroughly serve for purposes of reference, though, no doubt, it goes some way to this end. The secret may be that "Pure Geometry" is more limited in its range, has, on one side, to do with a book known to almost all, and, on the other side, even does not reach, for the generality, beyond the conic sections; "Analytical Geometry," on the other hand, has to do with everything that relates to curves and surfaces, of whatever sort they may be. Prof. Cayley takes the line of analytical geometry "as a method," and confines himself, in his twenty-four and a half columns, to the consideration of the applications of Cartesian co-ordinates

almost exclusively. The article is divided into the two sections of plane and solid geometry. At the commencement the student is recommended by the weight of Prof. Cayley's advice to trace a number of curves, and he draws a few simple ones, so drawing attention to a point upon which Mr. Frost, in his "Curve-Tracing," strongly insists. Prof. Clifford, too, we believe, had it in his mind to publish an account of some methods which "are exceedingly simple and easy of application; they partake more of the nature of a manual craft than of a purely intellectual occupation, and may so be used as a rest from severer studies; and, as we can only imagine things of which we have seen the like by appealing directly to the senses, they extend those powers of concrete realisation which the growing complication of modern analysis renders daily more desirable." The methods he alluded to are "Projection, a process by which no alteration is made in the order, the class, nor in any other purely descriptive property of a curve;" then "those modifications of form which leave the *order* of a curve unaltered;" then "those changes which exercise no effect upon the class." In the last two cases he proposed to use a process which he used to call "the *composition of curves*, by which a curve of any order or class may be built up out of the simplest elements" We fear that we have lost this proposed sketch, with the many other sketches he had outlined and lived not long enough to endue with a vitality he could so well have given them After the illustrations referred to Prof Cayley discusses shortly the metrical theory, and obtains the several familiar equations both in plane and solid geometry. In short paragraphs polar, trilinear, point, and line co-ordinates are described, but not applied. We have noted scarcely any misprints in the first article, but in the second there are several, all of which are easily detected. The figures are very well done.

We would draw attention to the article on Geodesy by Col Clarke, which we have read with much pleasure It is well illustrated, and the eighteen columns treat of the following matters.—Horizontal angles, astronomical observations, calculation of triangulation, irregularities of the earth's surface, altitudes, longitude These are as fully discussed as need be in a sketch of the subject, and we shall expect that Col. Clarke's more extended work on Geodesy, referred to in NATURE, vol. xxi. p 423, will take its place as a standard work for some time to come.

Geology occupies at the present day so important a position in the circle of the sciences that it deserves to be treated, in any modern cyclopædia, with no niggard hand. A slender essay, confined to a survey of the broad features of geology, would have been sadly disappointing in such a work as the "Encyclopædia Britannica." It is therefore satisfactory to observe that Prof. Geikie, to whom the editor entrusted this article, has put a liberal interpretation upon his trust. He has treated his subject with a fulness worthy of a great and growing science, and worthy too of the noble plan upon which the Encyclopædia has been projected. The masterly article which he has contributed to the new edition] stretches over more than 320 columns, and is thus longer than most of the kindred articles, such as those on "Astronomy" and "Chemistry." Possibly it might have borne, here and there, a little condensation, but on the whole it is admirably fitted for its place. It stands forth as a solid and comprehensive monograph which, if reprinted from the Cyclopædia, would form one of the most substantial treatises in our geological literature. But the article is not only substantial, it is, like all Prof. Geikie's writings, eminently readable. The cardina virtues of an encyclopædist are accuracy and conciseness of expression, and he usually finds but little scope for the play of literary graces. Prof. Geikie, however, is far too polished an author to write upon any subject in an unattractive style, and the present article is sufficient to prove—were proof needed—that his graceful pen does not fail him, even when discoursing on the knottiest point in geology. The comprehensive nature of this article, and the originality with which the subject is treated, may be best shown by explaining the seven-fold division adopted by the author. First he deals with the *Cosmical Aspects of Geology*, and not only discusses the shape and the motions of the earth, but stretches his survey to the probable history of the solar system. Then he inquires into the nature of the materials of the earth's substance—an inquiry which falls under the head of *Geognosy*. In the early part of the article the author may seem to trench a little upon subjects which are treated in other articles, but this is almost inevitable in any cyclopædia It is not to be expected that the several essays shall just touch each other without overlap, like the pieces of a neatly-jointed mosaic. The geognostic division of the article is followed by a section on *Dynamical Geology*, and this in turn by one on *Structural Geology*, or the architecture of the earth. Under the head of *Palæontological Geology* Prof Geikie sketches the history of life as revealed by the fossiliferous deposits, while in the following section on *Stratigraphical Geology* he traces the chronological succession of events in the history of the stratified rocks Finally a chapter is devoted to *Physiographical Geology*, or a discussion of the origin of the physical features of the earth's surface.

To see for the first time a great actor play the part of a familiar character is a treat, but the pleasure is seldom quite free from a mixture of disappointment His reading of the part is usually not our pet and peculiar one, and we are, as it were, bullied into contentment by the great power of the performer We felt something akin to it when we read the article "Heat" by Sir William Thomson, though the feeling was of course unreasonable. It often happens when for the second time we see a great actor play a great part we yield ourselves to his charm without a trace of intellectual reserve, so it will most likely be when next we read the article "Heat" At all events, the readers of NATURE may be assured that there is little in this article that they can justly find fault with, whatever they may miss to find that they expected Could it be otherwise, when the author is the pupil of Regnault, the colleague of Joule, one of the patriarchs of the modern science of thermodynamics, the greatest living authority on the theory of heat in Britain? We shall therefore most modestly discharge our function by pointing out to our readers what they will find in Sir William Thomson's article, and by slightly indicating some points on which, to our regret, he has withheld his opinion

The article opens with a discussion of the sense of heat, and of the distinction between heat and temperature We are thus introduced to the conception of latent heat, which is explained at some length. The two leading methods of calorimetry, viz. calorimetry by latent heat, and thermometric calorimetry, are then discussed in general terms, and the results of the comparison of the different calorimetric units by Regnault and others are given. Then follows a full account of the origin of the modern theory of heat, which regards it as energy, and measures it by the equivalent amount of work We thus have a third method of calorimetry, which is called dynamical calorimetry Of the thirty-five pages occupied by the whole article eighteen are devoted to thermometry. This is the most important, and certainly the most interesting part of the article. After discussing a theoretical (and to some extent practical) system of thermometry by mixtures of hot and cold water, the thermoscope being the sense of heat in the hand, the author gives an elaborate classification of the different possible kinds of thermoscopes Then comes an extremely interesting discussion of the merits of the different kinds of thermometers with arbitrary scales The defects of the mercury-in-glass thermometer, and the advantages which led Regnault to prefer the (constant volume) air-thermometer are fully explained We do not remember to have anywhere seen so full, and, it is needless to say, so philosophical an account of Regnault's results of the comparison of the different thermometric scales The rest of the part devoted to thermometry is more or less speculative The absolute thermodynamic scale of temperature, invented by the author himself, is defined, and its great advantage pointed out, viz., that it gives us a definition of temperature " such that, if a thermometer were graduated according to it from observation of one class of thermal effects in any one particular substance, it would agree with a thermometer graduated according to the same thermodynamic law from the same class of effects in any other substance "

Thermodynamic formulæ are investigated in a variety of cases for graduating thermometers, according to the absolute scale, from experimental data concerning the thermometric substance. A number of instruments are described in detail which are intended to realise these cases in practice We are thus introduced to the water steam, mercury steam, and sulphurous acid steam thermometers, and the constant pressure hydrogen thermometer These instruments are mostly new as to their details, and all of them are new in the sense that they have not been practically used hitherto Nevertheless a great future is predicted for them It would appear that Sir William Thomson has himself constructed models of them all; but whether he has used any of them in practical work he does not say It has doubtless occurred to many of our readers, as it has to us, to have doubts and difficulties about thermometric measurements Nowhere could we find better reasons for our scepticism than in the earlier part of Sir William Thomson's discussion of the systems of thermometry at present in use, we shall look, therefore, with all the greater interest for some farther account of the practical working of these new instruments. Their success, were it even but partial, would be an immense gain to thermal science. Thermal capacity and specific heat are next defined; and a brief account of the leading features of the results of different experimenters is given, without detail as to the methods employed in obtaining them. For further information we are referred to the articles on "Thermodynamics," "Matter," "Liquid," "Steam." The remaining five pages of the article deal with the transference of heat. Radiation is explained and distinguished from other modes of transference; but to our great regret is dismissed very briefly A criticism of the work of the various experimenters in this department from an authority like Sir William Thomson would have been most interesting There is still much doubt and difficulty hanging over the subject of the diathermancy of gases, for instance, we need scarcely mention as an illustration the famous controversy which has raged over water vapour It may be however that these and kindred matters are to be treated under "Radiation" or "Light"; although we are not referred to these articles The general principles of the theory of the conduction or diffusion of heat, as laid down by Fourier, are explained, and a most interesting critical account is given of the earlier attempts to measure conductivity The explanation of the causes of the failure of Clément and Péclet in measuring high conductivities, such as that of copper, is very instructive, and should be closely studied by those engaged in like researches. Of the methods in use for measuring the thermal conductivity (or diffusivity as the case may be) of solids, Sir William Thomson prefers that of Angstrom, and recommends along with it the use of thermoelectric methods for determining the temperatures along the experimental bar. The mathematical theory of this method is given, and its connection with the researches of Forbes and Thomson on underground temperatures pointed out The method of Forbes for measuring the conductivities of metals in absolute measure is described in general terms, and the results obtained with it by Tait are given, and compared with those of Ångstrom and Thalèn. We regret that no mention is made of the recent attempts to measure the conductivities of liquids and gases The only result given is that of Bottomley for water, and no description of the method accompanies it It is quite true that the success of many of these attempts has been somewhat doubtful, but, for that very reason, a criticism of the methods by a competent and impartial authority would have been most opportune, and useful as a guide to future experimenters. Appended to the article are a series of ten tables of thermal constants, and a reasoned synopsis of the principal mathematical formulæ that occur in the theory of diffusion. This last is a most valuable part of the article, for it could be given only by a master of the subject, and it is likely to be extremely useful to many physicists, who have sufficient knowledge to enable them to use such formulæ, but not sufficient mathematical power to find them for themselves, or sufficient time to hunt them up from ponderous treatises and half-forgotten memoirs when they want them.

We sincerely congratulate the editor and publishers of the *Encyclopædia* on the high degree of success which continues to attend their great undertaking.

OUR BOOK SHELF

Life and Her Children: Glimpses of Animal Life from the Amœba to the Insects. By Arabella B. Buckley (London: Edward Stanford, 1880.)

AFTER light came life, and with that life there came its two great functions—growth and development. With the simplest as with the most complex forms there is the same eager race to be run, to increase in size, to multiply, and thus replenishing this earth, to die "Life and Her Children" is a praiseworthy and admirable attempt to tell us something of the Children that Life sends forth, and of their history Its main object is to acquaint young people with the structure and habits of the lower forms of life, but in our deliberate judgment it will do a great deal more. None will read its introductory chapter without advantage, and few will read the volume through without enjoyment Within its narrow limits of 300 small pages no candid reader would expect to find all the details that might be wished for, or all the illustrations that might be desired What constitutes the book's chief charm is the marvellously simple yet quite scientific style which runs through it, the food for thought and future study which it affords, and the truly philosophic glow which lights up its every page The volume gives a general account of Life's Simplest Children, the Protozoa The word "slime" does not seem to us quite a happy term by which to designate the living protoplasm of these creatures; this word conveys the idea of a something adhesive or glutinous, or of a something thrown off a living organism—a something without a structure (sordies, eluvies)—and there seems somewhat of a "contempt for nature," a thought certainly never present in the author's mind, in the use of such a word Jelly would seem a more appropriate word, as conveying the idea of the consistency requisite for life, and would have the sanction of use. Thus the Noctilucæ, called in this volume "tiny bags of slime," were described, if we mistake not, by their discoverer as "tiny spherical gelatinous bodies," and Prof. Huxley says, "Noctiluca may be described as 'a gelatinous transparent body about the one-sixtieth of an inch in diameter'"

The chapter on "How Star-fish Walk and Sea-Urchins Grow" is excellent The story of how the five curious little oval jelly bodies swimming about by their jelly lashes in the depths of the smooth water in some English bay—ended in becoming respectively a lily star, a brittle star, a starfish, a sea-urchin, and a sea-cucumber, is well told, and woodcuts, though they make one see as in a glass darkly, help in their own way to make the meaning plain In the "Outcasts of Animal Life" a difficult problem is treated of It need not surprise one that it is not solved The last four chapters tell of "the Snare-Weavers and their Hunting Relations (spiders)", the Insects which change their coats but not their bodies, and those which remodel their bodies within cover of their coats, "the Intelligent Insects with Helpless Children, as illustrated by the Ants." This volume thus tells of the greater part of the living invertebrate animals as they are spread over the earth to fight the battle of life. "Though in many places the battle is fierce and each one must fight remorselessly for himself and his little ones, yet the struggle consists chiefly in all the members of the various brigades doing their work in life to the best of their power, so that all while they live may lead a healthy, active existence. The little bird is fighting his battle when he builds his nest and seeks food for his mate and his little ones, and though in doing this he must kill the worm, and may perhaps by and by fall a victim himself to the hungry hawk, yet the worm heeds nothing of its danger till its life comes to an end, and the bird trills his merry song after his breakfast, and enjoys his life without thinking of perils to come. So Life sends her Children forth, and it remains for us to learn something of their history. If we could but know it all, and the thousands of different ways in which the beings around us struggle and live, we should be overwhelmed with wonder Even as it is, we may perhaps hope to gain such a glimpse of the labours of this great multitude as may lead us to wish to fight our own battle bravely and to work and strive and bear patiently, if only that we may be worthy to stand at the head of the vast family of Life's Children."

The work forms a charming introduction to the study of zoology—the science of living things—which we trust will find its way into many hands E P W

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications*]

The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts]

Prof. Tait and Mr. H. Spencer

As Mr. Spencer has already got the length of calling some of my statements "fictions, pure and absolute," it is time that this discussion should cease. But it is necessary that I should at least show my reasons for having made the statements in question. They will be found ample

Mr. Spencer's pamphlet, which originated this discussion, and in which I am the first subject brought up for vivisection, bears on the title-page that it deals with *Criticisms*.

The only passages of mine which Mr Spencer quotes, which can possibly have the slightest reference to himself, and which can in any way be construed into criticisms, are but two in number. In these, or in one of them, the cause of his attack on me must be sought

The first is mainly a verbal transcription from Mr Kirkman, and as such it is none of mine; but in introducing it I inadvertently (though correctly) spoke of the "Formula of Evolution" as a *definition*.

The second is a passage *from a different part* of my article on Sir E. Beckett's book, and its application is to materialists and agnostics in general.

This latter passage did not appear to me capable of having roused the vivisection-instincts of so calm a philosopher as Mr. Spencer, especially as it was not applied to any one in particular. Of course, then, I at once assumed that the former passage contained the offence which was to be expiated, and I was confirmed in this idea by the way in which Mr. Spencer put his *formula* alongside of the Law of Gravitation. I could not have ventured to suppose that Mr. Spencer "*did not even know that he was in the habit of saying formula rather than definition.*" This *naive* confession cannot but be correct. Had it been made in Mr. Spencer's pamphlet, I should not have thought it necessary to say a word. It explains at once his frequent entire misapprehensions of my meaning So I give up my plausible theory of the origin of Mr. Spencer's attack on me, and shall, henceforth, ascribe that attack to my having made a singularly apt and telling quotation from Shakespeare!

With regard to the other parts of the discussion, I feel that I need not add anything to what I have already said; except on one point, an important one.

Mr. Spencer has employed an old remark of Prof. Huxley as to what mathematics can, and cannot, do, but he has not employed it happily, for the question at issue is really this —Is it correct to speak, at one time, of force as an agent which changes a body's state of rest or of motion, and again to speak of it as the time-rate at which momentum changes or as the space-rate at which energy is transformed?

I answer that there is not the slightest inconvenience here, except, perhaps, in the eyes of those metaphysicians (if there be any) who fancy they know *what* force *is*. Such phrases as "the wind blows," or "the sun rises," though used by the most accurate even of scientific writers, would otherwise (on account of their anthropomorphism) have to be regarded as absolute nonsense. P. G. TAIT

Geological Climates

It was with great surprise I read Prof. Haughton's unqualified statement in last week's NATURE, that—"It is *impossible* to suggest any rearrangement of land and water which shall sensibly *raise the temperature of the West of Europe*,"—since I had, as I thought, in my recently-published volume—"Island Life"—not only "suggested" such a rearrangement, but also adduced much evidence to show that it had actually occurred throughout the periods when both the West of Europe and the Arctic regions enjoyed a much higher temperature than they do now. I will now briefly re-state my "suggestion," and will also make a few remarks on the general causes of difference of temperature, which may serve to render the subject more intelligible.

It is now well known that places in the temperate zones owe their temperature at different seasons only partially to the amount of direct sun-heat they receive, but very largely to the amounts of heat brought to them by currents of air. Thus we explain, not only the mild winter climate of our islands as due to the prevalence of westerly and south-westerly winds which have become warmed by passing over the Atlantic, but also the wonderful inequality of temperature at different seasons of the year. When we have warm spring like days in mid-winter, it is because these warm currents of air are passing steadily over our islands; while continued hard frosts are as clearly due to masses of cold air from the north or north-east which drift down to us, often with no perceptible wind. Again, when in April and May we have days as cold as those of December and January, they can always be traced to northerly or easterly currents of air, and are probably often connected with the southern drift of the icebergs at that season. It is clear then, that if south-westerly winds were to continue throughout the winter, the severity of that season would be entirely abolished, and the same effect would be produced if by any means the winds from the north and east lost their severity.

Now the source of the constant warmth of our westerly winds is admitted to be the influx of warm water into the North Atlantic—chiefly by the Gulf Stream, and this warm northward flow of tropical water, being primarily due to the trade-winds, is not confined to the Atlantic, but is equally present in the other great oceans, and similar effects are produced in them, though nowhere to so great a degree as in our islands, owing to our insular position and the great extent to which Europe to the east of us is permeated by water as compared with North America or Asia. The North Pacific, with its great Japan current, is probably quite as warm as the North Atlantic; but Vancouver's Island, though further south than London, has not so mild a climate; and this can be clearly traced to the great mass of land to the east and north of it, the lofty snow-clad mountains, and the absence of those deep gulfs and inland seas which do so much to ameliorate the climate of Europe.

Prof. Haughton states, in his "Lectures on Physical Geography," that the Kuro Siwo, or great Pacific current, is two and a half times as large as the Gulf Stream, while the Mozambique current, which forms the outflow of the warm waters of the Indian Ocean, is one and a half times as much, so that these two currents have together four times the bulk and heating power of the Gulf Stream. If therefore these two currents at any time obtained an entrance into the Arctic Ocean, it is difficult to over-estimate their effect on its climate. The Gulf Stream, of which probably not half passes northwards of our islands, gives to Iceland the same winter temperature as Philadelphia, and keeps the North Cape (far within the Arctic circle) permanently free from ice, and this, notwithstanding the powerful counteracting influences of the lofty Scandinavian mountains on the one side, and the huge ice-clad plateau of Greenland on the other. Suppose that only an equal proportion of the Kuro Siwo entered the Arctic Ocean, is it not probable that no sea-ice at all would form there? While, if Greenland were less elevated and thus ceased to be an accumulator of ice, the combined effect might be to render the whole Polar area free of icebergs. This would at once do away with the chief source of winter cold to all north temperate lands, and ameliorate the climate of America as much, proportionately, as that of Europe.

But we have yet to consider a still more powerful agent in ameliorating the climate of Western Europe in Secondary and early Tertiary times. The heated waters of the Indian Ocean have now no northern outlet, and only penetrate the continent in the sub-tropical Red Sea and Persian Gulf. Now if we suppose the waters of the Bay of Bengal and the Arabian Sea to have had northward outlets through the heart of the Euro-Asiatic continent, penetrating in two or more directions into the then much more extensive Arctic Ocean, we should have an agency at work which would render the presence of any permanent ice in the North Polar area as impossible as it is now in Scotland. The cooling agency of ice being once abolished, the comparatively small area of the Polar as compared with the Tropical seas (about one-tenth) would facilitate the raising of the temperature of the former to perhaps 15° or 20° F. above the freezing point, and this would not only give the Arctic lowlands a climate quite sufficient for the vegetation which we know they supported, but, by doing away with the only source of our winter cold, would give our islands a perfect immunity from frosts and render them capable of supporting the vegetation now characteristic of sub-tropical lands.

That the modifications of land and sea here indicated *did* exist throughout a considerable portion of past geological ages, and that the existing consolidation of the great northern continents, to which the possibility of our present Arctic climates is mainly due, is a comparatively recent and abnormal phenomenon, I have endeavoured to prove in the work already referred to. At present I have only undertaken to show, that a "suggested" rearrangement of land and water adequate to raise the temperature of Western Europe to a very sensible, or even to a very large extent, *is* "possible." ALFRED R. WALLACE

Photophonic Music

I HAVE not yet met with any reference to the capabilities of the photophone for giving musical harmonies. Might not some curious effects be got in some such way as this:—Suppose a disk perforated with holes in four concentric circles corresponding to the notes of a chord; a beam of light to be sent through each circle to a lens and disk of rubber with tube (as Prof. Bell has described), the four tubes debouching in a cup-shaped cavity to be applied to the ear, lastly, the disk to be rotated variably by means of a small windmill or otherwise. Another arrangement might be to make the beams of light pass through the holes to selenium cells in four telephone circuits, the four telephones being placed in one frame, against which the listener's ear would be put, or coupled in pairs, one pair put to either ear. Again, might not harmonised tunes be obtained thus:—Suppose a broad open drum of wood or cardboard rotated uniformly on a screw forming a vertical axis. The drum is perforated in a spiral band of four lines of holes (for the light), corresponding to the notes of the harmonised air to be produced. This spiral band passes before four rubber disks or selenium cells (as in the former system), but arranged vertically and placed within the drum, at the lower part. The drum, it will be understood, works gradually down the axis, presenting a continuous four-line series of holes before the receiving apparatus. Again, a long continuous strip of cardboard, with four rows of holes, might be passed before the receiver in any convenient way. M.

The "Philosophy of Language"

THOUGH it is my principle never to answer any criticism of my writings, I find myself obliged to deviate for once from this rule by the character of your highly esteemed review, and by the desire to find a discerning appreciation from your readers, whose judgment has for me the greater value, as it is the main aim of all my works to restore the relations between the science of mind and natural philosophy. Therefore you would oblige me very much by publishing the following short remarks:—

The critic of my *brochure* ("Max Muller and the Philosophy of Language,") says, ". . . Nor is speech the deliberate product of a conscious will." Now it is the real aim of all my works on the philosophy of language to show how the human will—before dark and unconscious—grows to consciousness *by language* and human activity intimately connected with it. Can there be the least doubt of this, even if I refer only to the motto of my "Origin of Language,"—"Language has created reason, before language man was without reason"?

Your critic has made me say *just the contrary of what I really have said*. Besides, it would have been only fair if the critic had pointed to the following little passage of my *brochure*:—

"Max Muller has since expressed *his full assent* to this view," (viz., my theory of the origin of language).

Mayence, November 11 LUDWIG NOIRÉ

[I gladly accept the author's assurance that he adheres to the view that "language has created reason." At the same time his

express words as well as the general bent of his argument seemed to point in the opposite direction. Thus at p. 81 he writes:—"Language is a product of *association*. . . . Language is a product of an active, not of a passive, process, it is the child of *will*, not of sensation." The statement that language is "the child of will" seems to me practically identical with the assertion that "speech is the deliberate product of a conscious will," because the will here spoken of, being "an active process," is necessarily conscious.—A. H. KEANE.]

Notes on the Mode of Flight of the Albatross

WHEN watching the albatross one is struck with the fact that the bird gets up to windward without appearing to use his wings to a degree sufficient to account for the same. The sailors are satisfied with the explanation that he beats to windward. The conditions are of course not analogous to those of a ship sailing to windward. If the wind be very light, or if there be a calm, occasional powerful and obvious flapping of the wings occurs If there is no wind, the birds often settle on the water round the ship. In very heavy weather the birds disappear altogether, probably settling on the water. Except that for breeding they resort to the islands, I believe they frequent the open ocean, where the surface is seldom without more or less swell.

On watching the flight of the albatross, one observes that in order to rise from the water violent and obvious flapping of the wings is necessary, which is continued some time after the wings cease to strike the water. After a start has thus been effected, if there is a fresh breeze, the wings are kept almost motionless. Sometimes the bird goes some distance with the impetus derived from the flapping of the wings at the start, but sooner or later he turns so as to expose the plane surface of his wings full to the force of the wind, rising at the same time some height above the water, and drifts off to leeward, thus soon acquiring the velocity of the wind, then swooping down into the hollow between two swells, he turns his head to windward, and keeping close to the surface of the water, sails along more or less against the wind for a surprising distance; finally, rising over the crest of a wave comparatively high into the air, and turning with his wings as before, so as to catch the wind to the fullest extent, he again lets himself drift off to leeward

Thus the manœuvre he performs seems to consist in drifting with the wind in such a way as to attain its velocity very soon, and then turning round so as to make use of this velocity to carry him in the contrary direction

Of course if he still remained exposed to the wind which had imparted to him its velocity he would not travel far against it before he came to a standstill, and he would certainly make no progress to windward, but by keeping close to the surface of the water, and as much as possible in the hollows between the waves, he is almost out of the wind, and in this comparatively calm region the impetus derived from the wind will carry him a long distance in exactly the opposite direction to that of the wind itself

This manœuvre appears to be an important factor No doubt the almost imperceptible movement of the wings may assist, though that this alone is insufficient to account for the progress to windward appears evident from the powerful efforts made with the wings in rising from the water and in calm weather I have never had an opportunity to observe the albatross flying over land or over level water. If the manœuvre above described be an important factor, the birds then would have to use their wings much as they do in very light winds on the ocean If very strong winds were blowing, they would have to settle on the land or in the water in order to remain at the locality ARTHUR W BATEMAN

A General Theorem in Kinematics

PROF. EVERETT (*ante*, p. 99) has overlooked in the introductory paragraphs of Prof. Schell's paper, to which he refers for the original statement of the theorem re-discovered by Prof. Minchin, the acknowledgment: "Der Mittelpunkt der Beschleunigungen und jene beiden Kreise wurden bereits 1853 von BRESSE gefunden." The reference is to the *Journal de l'École Polytechnique*, tom. xx, "Mémoire sur un Théorème nouveau concernant les Mouvements Plans, etc" By means of the "two circles" Bresse determines the point *c* (*J*) "qui aura une accélération totale nulle" (p. 82), and then by very ingenious application of kinematic principles deduces those relations to it which any arbitrary point (*P*) has, as given by Prof Minchin. Bresse names *c* "second centre instantané de rotation."

University Hall, December 4 J. J. WALKER

Geometrical Optics

YOUR correspondent "P. C." (NATURE, vol. xxii. p 607) asks information concerning a work, in English or French, on geometrical optics, thoroughly explaining the optical construction of telescopes and microscopes. I am not aware of any such publication these last forty years, but deem it possible that it may interest your correspondent to know of the existence of such a work in German by von Littrow, entitled "Dioptrik, oder Anleitung zur Verfertigung der Fernrohre" It was published, I believe, in Vienna about 1838. W. G. LOGEMAN

High Burghal School, Haarlem, Holland, November 17

[Littrow's "Dioptrik" was published at Vienna in 1830 in 8vo —ED]

Ozone

IF a slip of the prepared paper, used for testing for atmospheric ozone, be carefully moistened on one side with alcohol, using a clean camel hair brush, on burning off the spirit and immersing the slip of paper in water the paper changes to a deep purple colour, as deep as No 8 in Negretti and Zambra's scale of colours for ozone.

Is this due to the development of ozone? as, according to Schonbein, heat destroys ozone. J. P.

Leicester, December 5

PLANTS OF MADAGASCAR

DURING the present year no less than four separate collections of plants have been received at Kew from Madagascar, including in the aggregate about a thousand species, represented by specimens complete enough to be botanically determinable. As the hills of the interior of the island attain an elevation of 10,000 feet, its range of climate is considerable. We now know not less than two thousand Madagascar flowering-plants, and probably have almost exhausted its ferns, to which the collectors have paid special attention, and which are about 250 in number, so that we may consider ourselves in a position to draw broad general conclusions as to the botany of the island.

Amongst the tropical types there are a considerable number of endemic genera The lemurs find their parallel in the vegetable kingdom in the *Chlænaceæ*, a natural order whose nearest affinities are with *Tiliaceæ*, *Dipterocarpeæ*, and *Ternstrœmiaceæ*, which is strictly confined to Madagascar, and comprises four genera and about twice as many species, to which the Rev R. Baron, in these new collections, has added a well-marked novelty in a second species of *Leptolæna*. Altogether there are certainly not less than fifty genera confined to the island, some of them very curious types, as *Dicoryphia* in *Hamamelideæ*, *Ouvirandra* in *Naiadaceæ*, *Asteropeia* (placed in the "Genera Plantarum" in *Samydaceæ*, but which Mr. Baron's excellent new specimens will most likely have to be removed to *Linaceæ*), *Macarisia* in *Rhizophoreæ*, *Deidamia* and *Physena* in *Passifloreæ*, *Hydrotriche* in *Scrophulariaceæ*, *Camelia*, *Tannodia* and *Sphærostylis* in *Euphorbiaceæ*, *Pachnotrophe* in *Moreæ*, *Calantica* in *Samydaceæ*, and several each in the orders *Rubiaceæ*, *Melastomaceæ*, and *Compositæ*. To these endemic types the new collections add at last three, *Kitchingia*, a fine new genus of *Crassulaceæ* allied to *Bryophyllum*, with five or six species named after the collector of the first of the four parcels, *Rhodocodon*, a monotypic genus of gamophyllous *Liliaceæ* allied to *Hyacinthus*, and *Micronychia*, in *Anacardiaceæ*, also monotypic, figured lately in Hooker's Icones Besides these the tropical flora of the island contains a large proportion. first, of endemic species of genera known elsewhere; second, of species

common to Madagascar, Mauritius and Bourbon, but not elsewhere known, such as *Pittosporum Senacia*, *Aphloia mauritiana*, *Gouania mauritiana*, *Nesæa triflora*, *Lobelia serpens*, and *Buddleia madagascariensis*, thirdly, of species that spread across Tropical Africa, such as *Haronga paniculata*, *Desmodium mauritianum* and *oxybracteum*, *Gynura cernua*, *Brehmia spinosa*, and *Mussoenda arcuata*, fourthly, of species spread universally through the tropics of the Old World, but not reaching America, such as *Crotalaria stricta*, *Oxalis sensitiva*, *Nymphæa stellata*, *Trichodesma zeylanica*, *Indigofera enneaphylla*, *Avicennia officinalis*, and *Rhizophora mucronata*, and fifthly, of species spread universally through the tropical zone of both hemispheres, such as *Eleusine indica*, *Tephrosia purpurea*, *Drymaria cordata*, *Elephantopus scaber*, *Teramnus labialis*, *Zornia diphylla*, *Waltheria americana*, *Sida rhombifolia*, and *Nephrodium molle*. In Mauritius and the Seychelles there are 145 species which occur also both in Asia and Africa, in addition to 225 which are spread all round the world in the tropical zone, and nearly all these 370 species are now known in Madagascar also. A small proportion of the Madagascar genera and species are Asiatic but not African, and these present collections add to the island flora *Lagerstromia*, *Buchanania*, and *Strongylodon*, three well-marked Indian types.

But perhaps still more interesting, in the light that it throws on the past history of the island, is the relationship of the comparatively limited flora of the mountains of the interior to that of other parts of the world. A certain number of the plants, especially the ferns and fern-allies, are widely-spread temperate species, which now have their head-quarters in the temperate regions of the northern hemisphere, we have instances of this in *Nephrodium Filix-mas*, *Aspidium aculeatum*, *Osmunda regalis*, *Lycopodium clavatum*, *L. complanatum*, *Sanicula europæa*, *Potamogeton oblongus*, *Sonchus asper*, *S. oleraceus*, *Polygonum minus*. Most of the characteristic types of the Cape flora are represented on the Madagascar mountains, but nearly always by species which are distinct from those which are now found in the extra-tropical regions of the main continent. for instance, the Aloes by a couple of species of *Lomatophyllum*, the Heaths by several species of *Philippia* and *Ericinella*, the bulbous Iridaceæ by species of *Gladiolus*, *Geissorhiza* and *Aristea*, the saprophytic *Scrophulariaceæ* by *Harveya obtusifolia*, the special Cape ferns by *Mohria caffrorum*, *Cheilanthes hirta*, *Pellæa hastata*, and *P. calomelanos*, the Proteaceæ by the curious genus *Dilobeia* (which Du Petit Thouars found at the beginning of the century, and of which Dr. Parker has now sent home the first specimens which have been seen in England), and the *Selagineæ* by *Selago muralis* of Bentham, which grows in the grounds of the Queen's palace at Antananarivo. But perhaps the most interesting feature of all is the occurrence of several striking cases of specific identity between plants of the Madagascar mountains and those of the tropical zone of the African continent. The only Madagascar violet (*Viola emirnensis*, Bojer, = *V. abyssinica*, Steud.) only occurs elsewhere high up amongst the mountains of Abyssinia, at 7000 feet above sea-level in the Camaroons, and at 10,000 feet above sea-level at Fernando Po. The only Madagascar Geranium (*G. emirnense*, H. B. = *G. compar*, R. Br. = *G. simense*, *latistipulatum* and *frigidum*, Hochst.) has a precisely similar area of distribution. *Caucalis melanantha* of Bentham is only known in Madagascar and amongst the mountains of Abyssinia. The Madagascar *Drosera* (*D. madagascariensis*, D.C. = *D. ramentacea*, Burch.) reappears at the Cape and the mountains of Angola and the west tropical coast, *Agauria salicifolia*, Hook. fil., which we noted lately as having been gathered by Mr. Thomson on the high plateaux of Lake Nyassa, is found in the Cameroons and on the mountains of Madagascar, Mauritius, and Bourbon, *Crotalaria spinosa* reappears in Nubia, Abyssinia, Angola, and Zambesi-land; *Asplenium Mannii*, Hook., on the mountains of Zambesi-land, the Cameroons, and Fernando Po. As a whole, it would seem that the flora of the Madagascar mountains corresponds closely with that of the great ranges of the tropical zone of the main African continent.

J. G. BAKER

BENJAMIN COLLINS BRODIE, BART., F.R.S., D.C.L.

ON Wednesday, November 24 last, died Benjamin Collins Brodie the younger, a worthy son of a distinguished sire. Born to affluence, but early imbued with the liberal and high-minded views of the great surgeon, he determined to devote his life and energies to the prosecution of science for its own sake, and well has he done his work. Brodie was born in London in 1817, and educated first at Harrow under Longley, and afterwards at Balliol, taking his Master's degree in 1842. In those days it was absolutely impossible to carry out original chemical work at Oxford, and Brodie naturally betook himself to Giessen, where Liebig's name drew students from all parts of the world. There in the summer of 1845 Brodie, at Liebig's suggestion, carried out analyses of certain waxes obtained by Gundlach by feeding bees on different kinds of sugar. The results thus obtained led him to continue his examination of bees'-wax on his return to England, and from his private laboratory in the Albert Road now came forth his well-known researches on the Chemical Nature of Wax (*Phil. Trans.* 1848, 147-170; 1849, 91-108), for which in 1850 he received the well-merited reward of the Royal Medal. These researches will always remain not only remarkable as having given a successful solution of a difficult problem, but as having proved, by careful preparation and exact analysis, the existence in wax of solid bodies which play the part of alcohols, and of which common spirit of wine is a direct lineal descendant. This unexpected discovery of solid alcohols containing respectively twenty-seven and thirty atoms of carbon in the molecule completely confirmed the truth of the views concerning the existence of an homologous series of alcohols first enunciated by Schiel and Gerhardt, and thus placed in firm position one of the chief pillars of the organic portion of our science.

Brodie's next work was not inferior either in importance or in workmanship to his first. In 1850 he published his memoir "On the Condition of certain Elements at the Moment of Chemical Change" (*Phil. Trans.*, 1850, 750-804), in which he carefully investigates the remarkable reducing action exerted by peroxide of hydrogen. Not only does this body lose half its oxygen when brought in contact with oxide of silver, but reduces this oxide to metal. This anomalous action was satisfactorily explained by Brodie, who pointed out that the second atom of oxygen in these peroxides is not only retained in an unstable state of combination, but that when brought into contact with silver oxide a true synthesis of oxygen occurs, two atoms of this element uniting to form one molecule of free oxygen. That this reaction really takes place was shown by Brodie to be the case by careful experiment. These results led him to consider the constitution of the alcohol radicals (*Chem. Soc. Journ.* iii. 405), and to assert in 1851 the important fact, now universally admitted, that the molecule of the radical ethyl contains four atoms of carbon. To him too we owe the prediction of the possibility of the existence of the mixed radicals, a prediction so soon afterwards experimentally verified by Wurtz. Next we find him active as secretary of the Society of which he afterwards became president, viz. the Chemical Society of London, also in lecturing at the Royal Institution on the allotropic changes of certain elements, on the formation of hydrogen and its homologues, in which

he clearly brings forward his views concerning the union of atoms to form the molecule.

In 1853 he published his interesting observations on the conversion of yellow phosphorus into the red modification by heating it to 200° in presence of mere traces of iodine (*Chem. Soc. Journ* v 289) Another very important and difficult investigation which occupied much of his attention about this time was the question of the purification (*Ann de Chimie*, 45, 351) of graphite, and the determination of its "atomic weight" (*Phil Trans.* 1859, 249). By heating graphite with strong nitric acid and chlorate of potash, Brodie showed that, unlike all the other modifications of carbon, graphite yields a remarkable crystalline acid, to which he gave the name of graphitic acid, having the formula $C_{11}H_4O_6$ The existence of this interesting body led Brodie to the conclusion that graphite may be considered as a peculiar radical, to which he gave the name of graphon In the year 1855 Brodie was appointed Waynflete Professor of Chemistry in the University of Oxford, a position which enabled him to throw all his influence into forcing the recognition of chemical science as a proper object of academic training Under his fostering care the science which had hitherto been so long neglected put out distinct signs of life new laboratories and lecture-rooms were built, to which students flocked in numbers, and Oxford saw the unwonted sight of her professor of chemistry busily engaged in original investigation, as well as in the tutorial duties of his chair The discovery of those singular and dangerous bodies, the peroxides of the organic radicals (*Proc.* Roy Soc. ix. 361, *Phil. Trans* 1863, 407), was made in the laboratory of the New Museum. The same laboratory soon afterwards saw the minute and careful investigation on ozone (*Phil Trans* 1872, 432), which proved beyond doubt or cavil that the supposition that the molecule of ozone is represented by the formula O_3 is both necessary and sufficient to explain all the observed phenomena

Next we find him experimenting on the synthetic production of the hydrocarbon methane, as well as of formic acid, by the direct union of hydrogen and carbon monoxide under the influence of the electric spark. Then he examines the effect of an induced electric current upon pure and dry carbonic acid, and proves that this gas is partially decomposed with formation of carbon monoxide and oxygen, the latter gas being converted into ozone And he then proceeds to ask whether the ozone thus produced is identical with that obtained from ordinary oxygen, and by a series of careful quantitative experiments demonstrates the identity of the ozone from these two sources

This was Brodie's last experimental investigation Ere long he resigned the Chair of Chemistry at Oxford, regretted by the whole University. He retired to his charming seat on the summit of Box Hill Neither his own scientific activity nor his deep interest in the scientific work of others ceased on his withdrawal from professional life Before his retirement he had put forward (*Phil Trans.* 1866, 781-860) in his "Calculus of Chemical Operations," views altogether novel respecting the nature of chemical change. In place of the usual mode of considering this as due to a change in the relative positions of the atoms of which matter is composed, Brodie founds his theory of the constitution of chemical elements and compounds on the simple volume-relations discovered by Gay-Lussac to exist between these substances in the gaseous state To hydrogen Brodie gives a simple symbol, because the unit of hydrogen can, as he expresses it, be conceived as made at once by one operation, whilst to oxygen he gives a double symbol, because it cannot, according to him, be made by less than two operations. The element chlorine is supposed to be made up of three operations, and a treble symbol is given to this body Concerning the probable or possible decomposition of the elements Brodie naturally speculates His analysis had led him to suspect that "chemical substances are really composed of a primitive system of elemental bodies analogous in their general nature to our present elements, some of which we possess, but of which we possess only a few" ("Ideal Chemistry," p 54) But no experimental evidence of this fact was offered by him, and none of a satisfactory character was otherwise forthcoming, until Victor Meyer announced his belief that chlorine was capable of undergoing decomposition at high temperatures

Here was a proof of the truth of Brodie's complex symbol! Sad to say, further experiment has not corroborated this conclusion. No substance differing essentially from chlorine has yet been got from this body. Even the change of density at a white-heat appears in the case of chlorine to be, to say the least, doubtful So we are left for the present, and the author of the "Calculus of Operations" is left for ever, without the experimental confirmation of his conclusions which he so much desired Whatever may be the verdict of the future as to the value of Brodie's Calculus, there is no doubt that science is indebted to him for an altogether new view of chemical combination obtained by a systematic analytical process '

This occasion is not a fitting one to enlarge upon the high personal character of the late Sir Benjamin Brodie Suffice it to say that in all relations in life, in the domestic circle as in society, in the chair at Burlington House as in that at Oxford, he displayed all those qualities of heart and head which alone give dignity and sweetness to life, the possession of which ensures for his memory a lasting place in the minds of all those who were fortunate enough to count him amongst their friends H. E R.

THE PHYLLOXERA IN FRANCE

THE new vine-disease, due to the *Phylloxera vastatrix* Planchon, has already caused much damage to the French vineyards and wine-production From the taxes arising from that national industry France derives a considerable part of her revenue; and this subject has consequently occasioned innumerable publications and investigations Of the latter some have been empirical and without result, others, which were conducted scientifically, have alone been of any use It was moreover absolutely necessary to have an unswerving confidence in exact observations, in order to persevere in making experiments which are often disturbed and rendered apparently self-contradictory by the secondary and ever-varying conditions of cultivation These experiments have at last been crowned with success, and now there are decidedly good grounds for hope For the last two years the public have shown a steadily increasing confidence in scientific methods

One of the most distinguished chemists, a man of whom France is proud, and with whom readers of NATURE are well acquainted, especially as they were lately presented with his portrait and biography, M Dumas, applied himself to the study of the Phylloxera, and pursued his task from day to day with keen determination, notwithstanding the attacks of some and the discouraging advice of others. It is his well intentioned and unceasing diligence that we must thank for never having lost heart, it is to him that those results are due which are presently to be indicated When the pébrine-disease was raging on silkworms in the South of France, it was by his personal suggestion and repeated encouragement that M Pasteur agreed to devote himself to that difficult study, and it is the same gentle influence and guidance that have directed the present writer, together with several others, especially MM Balbiani, Duclaux, and Mouillefert

Henceforward the principal problems raised by the study of vine diseases are solved They were solved one after another in regular order, as fresh light appeared and the ends to be aimed at became more definite It cannot

be too frequently repeated that that is due, not to a happy hit or to guess-work, but to an unceasing and skilfully conducted struggle which was kept up with indomitable persistence in the midst of obstacles caused by many selfish interests. Times are greatly changed since M. Dumas[1] protested, in discreet but unmistakable language,

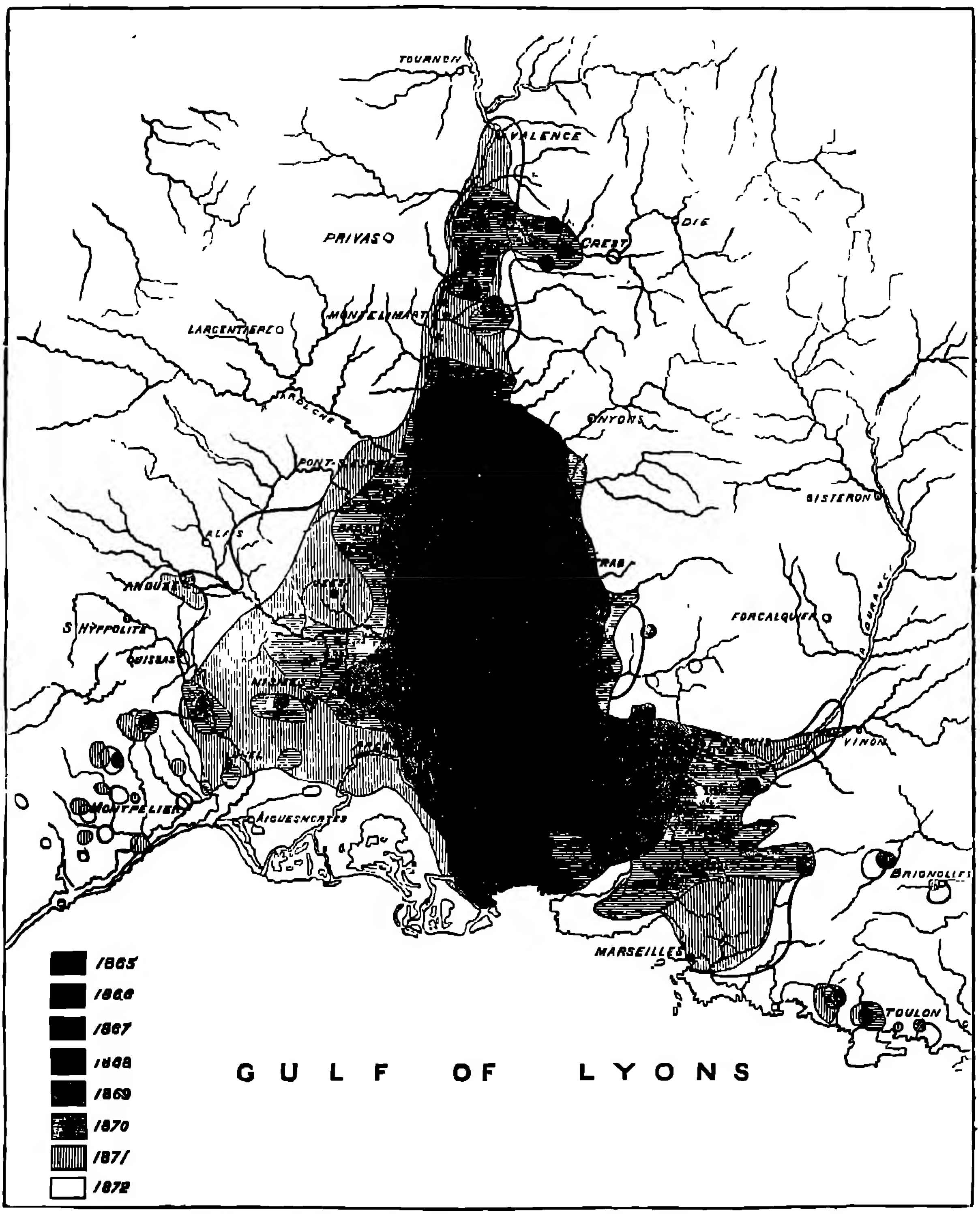


FIG 1 —Map showing the spread of Phylloxera in France from 1865 to 1872 (See NATURE, vol x p 504.)

against the indifference of a French Minister of Agriculture who tried to beat down a grant of 10,000 francs necessary for continuing the scientific investigation. On the same occasion he drew attention to the praiseworthy initiation taken by the railway companies and by various private gentlemen. M. Tirard, the present Minister of Agricul-

[1] Académie des Sciences, February 23, 1874.

ture, has obtained several large grants,[1] and proposes to ask still much larger ones for the approaching campaign, being anxious to assist in every way the laborious struggle. M. Tisserand, the new Director at the Office of Agriculture, a man of great energy and ability, has resolved to back up all his efforts, and has instituted a special central staff to take charge of all documents and operations. The Higher Phylloxera Commission, formed by order of the Minister, has also shown activity. it has adopted a general legislative scheme in order to supply the Government with the arms necessary to defend the threatened territory.

Switzerland and Germany soon adopted similar measures; and with reference to England we must remark that the Phylloxera question may soon become something different from a mere matter of curiosity. Are there no important vineyards in England? We are told that at Liverpool alone, in the "Vineries," there are forty hectares of vines grown under glass. The Phylloxera was observed by Mr. Westwood before it was known in France. It is still found here and there in Ireland, in Scotland, and not far from London itself. By the admirable cultivation under glass, in which English vine-growers are unrivalled, it is kept within narrow limits, but it might

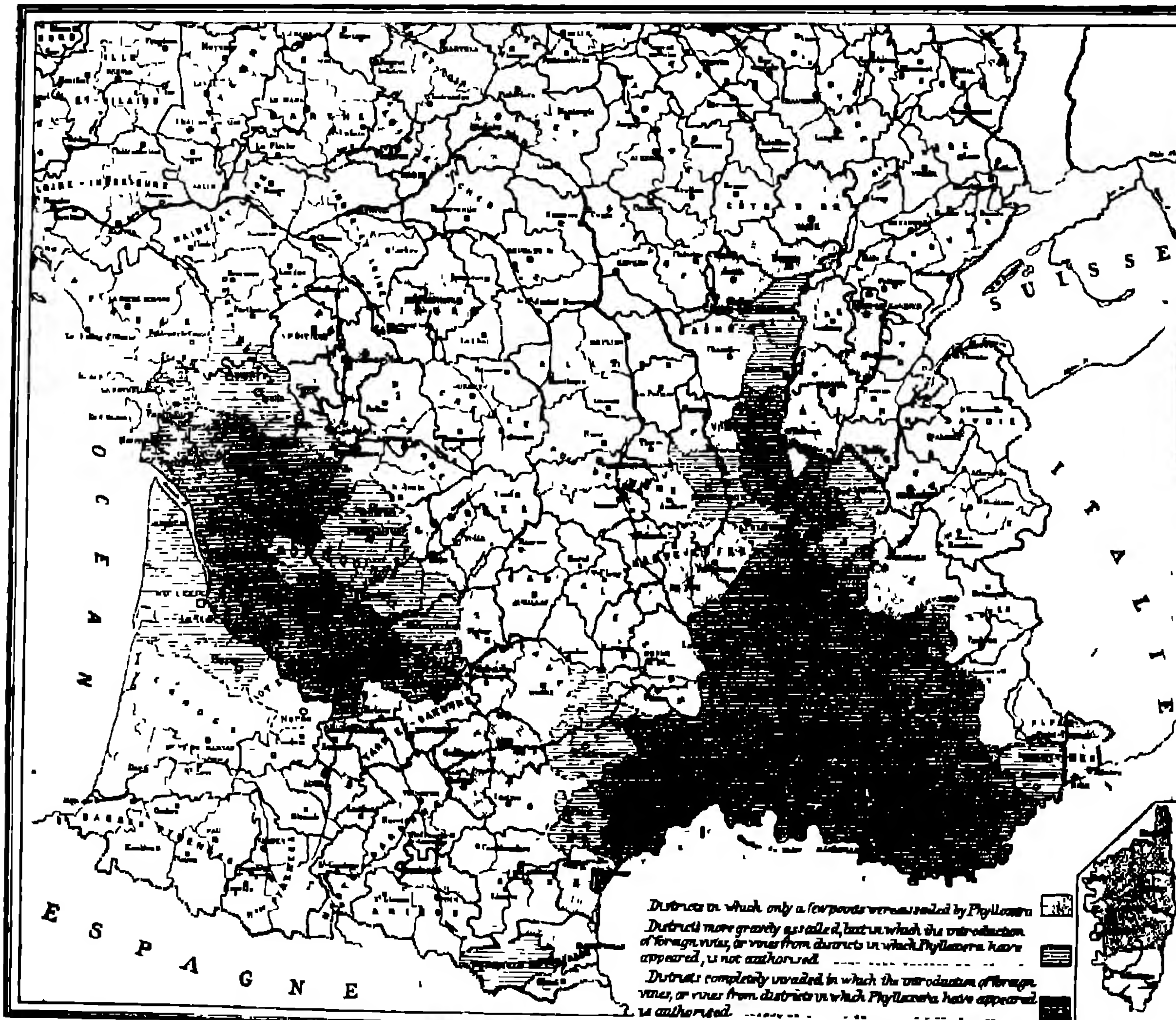


FIG. 2.—Map showing the spread of Phylloxera in France up to 1880.

be communicated to other places. In Switzerland one single parcel of plants is reported to have brought the parasite to Geneva, Schaffhausen, and Neuchâtel In any case, should an international convention be instituted, the enforced examination at the frontiers would hamper the trade in those magnificent English grapes The rigorous measures taken against the cattle-disease suffice to show what may be necessary in order to defend the leaf or shoots of the vine.

Extent of the Disease.—The increase of the disease is considerable; thus at the beginning of 1877 there were only twenty-eight departments attacked, whereas at the beginning of 1879, according to the official statistics, there were thirty-nine. Those in the previous year, in order of date,[1] were Loir-et-Cher, Haute-Garonne, Gers, and Corrèze. In 1878 Aude, Pyrénées-Orientales, Haute-Loire, Vienne, Indre, Côte-d'or, and Savoie. In 1879, Haute-Savoie, Jura, Arriège, and Tarn. A special inquiry enables us to determine what area had been invaded in the end of 1879 —the invaded vineyards which had not yet succumbed were 319,760 hectares in

[1] One of 500,000 francs, which has since been doubled.

[1] "Le Phylloxéra, &c., Rapports publ par le Ministère de l'Agric." 8 fasc., p. 9. (Paris: Masson, 1879)

extent, or 76,722 more than the preceding year, the vineyards destroyed, 474,760, or 101,317 more than the preceding year (1878).

There is unfortunately reason to fear that the isolated points may join each other and the affected patches unite. The patches, whether distinct or uniting, increase about 15 kilometres every year; and since the increase in any direction is proportional to the time, the increase of area is as the square of the time In other words, after 2, 3, 4, 5 years, the evil is increased 4, 9, 16, 25 times By merely looking at a map showing the extent of the plague, one can form an idea of the invading march of the terrible insect

Yet there are actually men of science in France who join in depreciating those who are employed to battle with this fatal disease It is sad to see the reception met with by those who have sacrificed their time, health, and scientific reputation to undertake duties so beneficial to their country. "They are merely wasting their time," say they, "much better not have left their personal duties," and, true enough, those of whom this is said have cruelly felt its truth. M Dumas, however, is not one of those.

Several years ago a prize of 300,000 francs was instituted to encourage investigations as to the best remedy against the phylloxera Much ingenuity was wasted, many absurd remedies proposed, and it is curious to note the substances which were lauded by the inventors They were for the most part the same, mixed in different proportions—tars, sulphur, lime, soot, urine, phenic acid, and salts of copper or iron. Patient research and scientific study have alone produced certain results.

These results, however, were not accepted and acknowledged without difficulty. Objections were accumulated and many instances of partial failure were brought together, ill-will and inertia playing an important part in the business Local influences, political opinions, and other extraordinary considerations, one after another, opposed or favoured the results which were gained At present the question has once for all entered upon a better path, the charlatans and pretended vine-doctors having entirely lost their credit We are in possession of four modes of treatment which are really efficacious, though they vary in their effects in different cases The struggle therefore should be maintained

The various conditions of application and the entirely different principles which the application follows explain the divergence of opinions and methods The scientific remedy is given practice will decide which of the four methods is at the same time most efficacious and most economical. This happy result must mainly be attributed to the Commission of the Academy of Sciences, which was presided over by M. Dumas, who was the very soul of it This Commission sent "delegates," who severally studied special clearly-defined questions, like officers sent by a general to make a reconnaissance in a country

The commissions instituted in the departments did much good work, especially that of Hérault, which contained several distinguished members, both vine-growers and scientists: MM. Marès and Planchon, Members of the Institute of France; M. Bazille, Senator, M. Vialla, &c. We must also notice particularly the Viticultural Station at Cognac, which was established by private subscription, after the English manner,—a thing of rare occurrence in France. It was M. Lecoq de Boisbaudran, now Member of the Institute, the discoverer of the metal *Gallium*, who first started the idea, and triumphantly realised it in his native town. The principal houses in the trade made it a point of honour to subscribe, and the expenses in four years reached a sum not less than 32,000 francs. It was there that the general experiments as to "insecticides" were made, in accordance with the simple method proposed by M. Cornu, Director of the Viticultural Station, in order to determine definitively what substances are powerless This work of "clearing the way" necessarily occupied several years, the practical part being energetically carried out by M. Mouillefert, of the National School of Agriculture at Grignon, near Paris, sub-director of the Viticultural Station Towards the end of the first year they began to distinguish clearly the small group of substances which alone should be utilised. Amongst them was carbon disulphide (CS_2), which had been indicated by Baron Thénard, abandoned and then eagerly resumed by the enthusiastic M Monestier, and at last rejected in a general manner in the end of 1873 and during 1874

The carbon disulphide by itself appearing too dangerous to human life, M. Dumas happily started the idea of using it in combination with sulphide of potassium, forming the sulpho-carbonate of potassium ($KSCS_2$), which is both a powerful "insecticide" and an energetic manure

The conclusions reached by the experiments made at Cognac were published towards the end of 1874 in the Report of the Academy of Sciences (last quarter), and the author can still defend every one of them as they were then deduced, a rare circumstance in connection with the phylloxera.

Under the happy influence of the Minister of Agriculture, the vine-growers were grouped into "vigilance-committees" for watching, and "syndicates" for treating, the vines Thus the indifference of some and unreasoning excitement of others were followed by energetic preparation for the struggle At the end of 1878 there were sixty committees instituted in fifty-six departments, and now there are 221, embracing sixty-one departments Some of them have obtained decidedly successful results, and thus furnished a powerful incentive for the others to persevere.

The expense of the applications is still considerable, but in any case the most valuable vines are now out of danger. The more common vines will at first cost a good deal, but we are confident that scientific skill will supply sulphate of carbon either free or in combination at a cheaper rate, and that practical experience will render its application more easy and less expensive France will thus continue to produce her wines, and have the pleasure of offering them to her friends and neighbours This, though apparently a mere wish, is an actual statement of fact

MAXIME CORNU,
Delegate of the Academy of Sciences, and formerly Director of the Viticultural Station at Cognac

NOTES

THE following are the arrangements for the Friday evening meetings of the Royal Institution of Great Britain before Easter, 1881 —January 21, Warren De La Rue, D.C.L., F R S., Sec. R I, The Phenomena of the Electric Discharge with 14,400 Chloride of Silver Cells, January 28, Dr Andrew Wilson, F.R S.E, The Origin of Colonial Organisms; February 4, Dr Arthur Schuster, F.R.S, The Teachings of Modern Spectroscopy; February 11, Robert S Ball, LL D, F.R S, The Distances of the Stars, February 18, Sir John Lubbock, Bart, M.P, D.C L., F.R S., M R I, Fruits and Seeds, February 25, Dr. J. S Burdon Sanderson, LL.D, F.R S, Excitability in Plants and Animals; March 4, Sir William Thomson, LL.D., F R S, Elasticity viewed as Possibly a Mode of Motion; March 11, uncertain, March 18, Wm. H. Stone, M D., Musical Pitch and its Determination, March 25, Alexander Buchan, M.A., F.R.S.E., Sec Met. Soc. Scot., The Weather and Health of London, April 1, uncertain; April 8, Prof. Tyndall, D.C.L., F.R.S., M.R.I.

THERE is nothing that will tend to keep our learned societies in so wholesome a condition as healthy public opinion; it is

therefore a matter for congratulation when we see a paper like the *Times* taking an interest in the organisation and work of the Royal Society, and giving its opinion on these, even when the justice of that opinion is questioned by many. From a leading article in the *Times* of Thursday last, on Mr. Spottiswoode's address, we take the following passage:—"The election to the vacancies in its ranks has of late years been too manifestly governed by a tendency to set up as an idol something which it is technically fashionable to call 'research,' and to ignore the far higher mental effort which is required for successful ratiocination. A man sets to work with a microscope and a test-tube, performs a number of curious experiments, and announces an interesting discovery which can neither be confirmed nor refuted by any one who does not follow precisely in his tracks. Such an experimenter, before now, has been rewarded by the privilege of placing the letters F R S after his name, although, when the privilege had been conferred beyond recall, it may have been shown that his 'research' was undermined by the neglect of some essential precaution, and that his conclusion was erroneous. On the other hand, the man who gathers up the scattered facts ascertained by others, and founds upon them a weighty and important generalisation, is not on that account thought worthy of the Fellowship, and if he desires to obtain it is almost compelled to engage in some colourable 'research' as a means of gratifying his wishes. The principle thus acted upon is as much a mistake as it would be to glorify a carpenter or a mason and to ignore an architect, and it points to a narrowness of view which might profitably give place to a more accurate sense of relative proportion. The award of a medal to Prof Lister, notwithstanding the great and direct utility of his work, is possibly an indication that better counsels may in time be expected to prevail."

WE understand that the Rev. Osmond Fisher has in the press, and will shortly publish, a new work entitled "Physics of the Earth's Crust." The volume will contain selected and revised portions of papers which have appeared at various times in the *Transactions* of the Cambridge Philosophical Society and other scientific publications, together with new matter. Mr. Fisher will in some chapters apply mathematical methods, but there will be found much matter calculated to interest those readers who do not care for that mode of reasoning.

THE meeting of the British Medical Association for the year 1881 will be held at Ryde, in the Isle of Wight, to which locality the Association has received a cordial invitation from nearly the whole of the medical profession in the island Mr Benjamin Barrow, an old and much-respected practitioner in Ryde, has been appointed president-elect. The Council of the Town of Ryde have passed a unanimous resolution that the whole of the Corporation Buildings, which are numerous and spacious, shall be placed at the disposal of the Reception Committee. There is every reason to believe, that the many beautiful private grounds in the Isle of Wight will be thrown open to the Association. The president will give a garden party to the members and residents in the island. A *soirée* will be held in the Town Hall and adjoining buildings The address in medicine will be given by Dr. John Syer Bristowe, London, of St. Thomas's Hospital, the address in surgery will be given by Mr. William Dalla Husband of Bournemouth, Consulting Surgeon to the York County Hospital; and an address in obstetric medicine by Dr. John G. Sinclair Coghill of Ventnor. Such has been the spirit with which the movement has been taken up by the Members of the Association and profession in the Isle of Wight and Ryde that the meeting bids fair to rival any previous meeting both in science and pleasure.—The following grants in aid of scientific investigation for the year were made, viz:—Dr. McKendrick and Committee, Glasgow, for a continued investigation on anæsthetics, 25*l.*, Dr Gerald Yeo, London, on the efficacy of the antiseptic method in injuries of the brain, 50*l*, Dr Shin, London, for a continued investigation on parasitic skin diseases, 25*l.*, Mr W. North, London, for a continued investigation on the relations which exist between nitrogenous egesta and muscular work, 50*l*, Dr D. J Hamilton, Edinburgh, an investigation on the pathology of the brain, 30*l*, Mr. Watson Cheyne, London, an investigation on the relation of organisms of septic disease, 25*l*, Dr. Augustus Waller, London, an investigation on the time and relations of muscular contractions in the human body in health and disease, 20*l.*; Dr. Alexander Ogston, Aberdeen, a continued investigation on the relation between bacteria and surgical disease, 10*l.*; Dr. Newman, Glasgow, a renewed grant in aid of an investigation on the functions of the kidney, 10*l.*, Drs Braidwood and Vacher, Birkenhead, to illustrate the third and final report on the life history of contagium, 20*l*

IN the Vienna Gewerbeverein, Herr F. Siemens has been lecturing on his "regenerative gas-burner," in which the departing heat of the flame serves for pre-heating the air and the gas to be consumed The products of combustion of the flame, collected in a short chimney, flow away cold, either into the room or to the open air The light, according to measurements, has twice to three times the illuminating power of the best-known gas burners, and is remarkably white and steady

THE death is announced of Dr. Lauder Lindsay, F R S E. F L S., at Edinburgh, on November 24, at the age of fifty. Dr Lindsay's name must be known to our readers as an occasional contributor to our columns Dr. Lindsay did some good work in botany and geology, and took special interest in the subject of intelligence in the lower animals. In 1870 he published a "History of British Lichens," and quite recently we reviewed his work on "Mind in the Lower Animals," published last year

ON Monday a deputation, consisting of Mr. Ernest Hart, Prof. Chandler Roberts, F.R S, Col. Festing, the Rev H V. Le Bas, the Rev S. A Barnett, Mr S. Hadley, Mr. W. R. E. Coles, and others, had an interview with the Lord Mayor at the Mansion House, to interest him in the efforts now being made by the joint committees of the National Health and Kyrle Societies to reduce the mischief arising from the present excessive production of smoke in the metropolis. Mr Ernest Hart said the Societies thought that a very great deal might be practically done to make the atmosphere in London as pure as that in Paris It was proposed to conduct trials of the various kinds of fuel and to promote competitive testing of the appliances available at present, or which might become available, for the purpose of lessening the production of smoke. The smoke proceeding from the fires of private houses might be materially lessened by the use of improved apparatus, and that from factories might be abated with little interference with the manufacturing interests if the employers would only co-operate with the Societies towards that end There was about to be an exhibition at South Kensington of the different kinds of apparatus and fuel, which would be practically tested. They now asked the Lord Mayor to let them bring the matter before the notice and attention of the citizens by means of a meeting at the Mansion House on the subject. The Lord Mayor thought it a matter well deserving the public attention, and he would gladly allow a conference in the Long Parlour of the Mansion House on Friday, January 7.

IN connection with the subject of Incandescent Electric lighting it is of interest to notice in the New York *Times* an account of an experiment in this direction. At a reception given on the evening of November 17 by Prof Henry Draper to the members of the National Academy of Sciences, a part of his house was

lighted by the Maxim light. The laboratory was lighted by eight Maxim electric lamps, which were screwed into the chandeliers in place of the ordinary gas burners. The large laboratory, it is stated, was as light as the open fields at noonday, and there was no flickering or unsteadiness in the light. In shape the lamps are precisely similar to those used by Edison, but H S Maxim, who holds the patent on them, claims to have improved on Edison's plan, by making his lamps more permanent. Like Edison, he uses a carbonised fibre, in the form of a horseshoe, but unlike him, does not inclose this fibre in a vacuum, and considers that his lamp is complete. An atmosphere of gasoline vapour is introduced into the glass globe which holds the carbonised fibre, and in this atmosphere the fibre is gradually heated by the electric current. As soon as the heat reaches a sufficient intensity it begins to decompose the hydrocarbon of which gasoline vapour is composed, and if there are any weak spots in the filament the freed carbon is deposited there and strengthens the fibre. A current of increasing intensity is thus carried through the carbonised fibre, which constantly grows at the expense of the gasoline vapour, and finally becomes of a uniform power of resistance throughout its whole length. The gasoline vapour is then pumped out of the globe and the lamp is ready for use. The Maxim lamps are said to give a larger amount of light than any incandescent lamp hitherto constructed. According to experiments made by Prof. Morton, of the Stevens Institute, it appears that the lamps have produced light at the rate of 600 candles per horse power of current. Each of the eight lights in Prof Draper's laboratory had an illuminating power of about fifty candles. The electric current for the lamps was furnished by a Maxim dynamo machine, which was driven by a gas engine of four-horse power, located in the laboratory. The Maxim machine has an armature something like that of the Gramme machine, while its field magnets resemble those of the Siemens machine

THE recent importations into this country of cinchona bark from Jamaica and the high prices realised have been the means of causing a considerable amount of attention to be drawn to this new source of supply. From a document recently drawn up by Mr. Morris, Director of Public Gardens and Plantations in Jamaica, it seems that the results of the cinchona sales for the year 1879-80 have been as follows:—Quantity of bark shipped 27,399 lb., gross amount realised £5380 9*s* 6*d*., net sum realised £5146 8*s*. 7*d*. Without going into details it will suffice to show the superiority of Jamaica bark over that from Ceylon by saying that for red "root bark" the highest price for Jamaica produce was 4*s*. 8*d* per pound for "good root" as against 2*s*. 6*d*. for "good root" from Ceylon, thus showing an advantage in favour of Jamaica root bark to the extent of 2*s*. 2*d*. per pound. Thus again for "twig and small ordinary" bark of *C. succirubra* Ceylon produce obtained from 2½*d*. to 1*s* per pound as against 10½*d*. to 1*s*. 6*d*. per pound for similar bark from Jamaica. From this, together with the fact that an enormous number of plants are now in stock in Jamaica, the future of cinchona cultivation in that island seems to be ensured.

IT is stated in an American contemporary devoted to electrical topics that a call has lately been made on the shareholders of the Edison Electric Light Company to the amount of sixty dollars per share. The object of the call was "to meet the expense of recent experiments."

IMPORTANT trials have been made lately on the Rhine, in order that navigation may be carried on at night by means of the electric light. It is hoped that soon satisfactory results will follow, which will probably develop an entirely new phase in river navigation.

IN the neighbourhood of Agram, at the mountainous places St. Simon and Remete, some shocks (of slight importance) were felt up till December 1. At Dortmund, on November 27, a considerable shock occurred at 5 50 a.m. It lasted several seconds, and the direction was south-south-east, barometer 756, temperature 7° R. A rather smart shock of earthquake, accompanied by a loud subterranean noise, was felt at Schaffhausen on Wednesday night last week The Rev. Dr. Dixon of Beragh, near Omagh, writes that a slight earthquake shock was distinctly felt there on the afternoon of Sunday, November 28, at about half-past five. The peculiar character of the shock was most marked. It appeared to travel from south-west to north-east.

IN the course of his experiences as a medical missionary among the Mongols the Rev. James Gilmour has gathered some interesting information regarding their inner life, but perhaps the most curious item is that Mongol doctors are not entirely unacquainted with the properties of galvanism. It is said that they are in the habit of prescribing the loadstone ore, reduced to powder, as efficacious when applied to sores, and Mr. Gilmour states that one man hard of hearing had been recommended by a lama to put a piece of loadstone into each ear and chew a piece of iron in his mouth!

THE French Great Western Company instituted last year a competition in the large hall of St. Lazare Station, between the Jablochkoff and Lontin light and the gas company. The conclusions were in favour of the electric light, but the gas company having declared that they would abolish entirely the special price charged on the Great Western Company if they declared in favour of gas, the gas lamps have been restored.

Les Mondes gives the following old recipe for testing the age of eggs, which, it thinks, seems to have been forgotten. Dissolve 120 grammes of common salt in a litre of water. An egg put in this solution on the day it is laid will sink to the bottom; one a day old will not reach quite to the bottom of the vessel, an egg three days old will swim in the liquid, while one more than three days old will swim on the surface.

THE *Launceston Examiner* (Tasmania) of October 6 contains some account of a shaft that had been sunk for a well at a brewery at Launceston, near the river. Little water was met with, but some interesting observations were made The shaft had been sunk to a depth of ninety eight feet. The strata passed through are of a very interesting character. For a little over thirty feet strong clay was met with, then deep beds of compact sand separated by bands a few inches thick of fine quartz conglomerate. About forty feet from the surface considerable quantities of partially carbonised wood were found, extending thence to the bottom of the shaft. The wood is evidently pine, and appears to be identical with that found in the shaft of the Working Miners Company at Brandy Creek, at a similar depth below the river. The grain of the wood is perfectly distinguishable, but the transverse fracture is black and lustrous like jet. The trees must have been of a large size and very abundant, and the great mass of earth that has accumulated above their remains enables one to form some idea of the vast period that has elapsed since they flourished. The great depth of the stratum in which this fossil wood occurs proves that its deposition must have proceeded without material interruption through vast periods of time. It is a little curious that though vegetable remains occur so profusely in the freshwater deposits of the Windmill Hill, and at considerable depths both here and at Beaconsfield, no trace has yet been found of contemporaneous animal life.

THE *Cape Argus* for November 6 contains a full report of a paper read at the Cape Philosophical Society by Mr J. G. Gamble, containing many useful suggestions as to important problems, especially in meteorology and geology, that await solution in South Africa. Residents and travellers in South Africa would no doubt find the paper suggestive.

PHYSICAL NOTES

MR. J. E. H. GORDON has lately patented a method of producing light from electricity based upon Mr. Spottiswoode's suggestion to apply the alternating-current magnetoelectric machine of De Méritens to the induction-coil Mr. Gordon arranges small balls of platinum or iridium, or of an alloy of these metals, at the ends of fine platinum rods in pairs in the middle of a suitable globe, and causes to pass between them a rapid succession of sparks whereby they are raised to incandescence There is no consumption of carbon or any other substance, and the lamps may be connected either in series or in parallel branched arcs. The principal remaining disadvantage is the noise attendant on the rapid sparks. A mechanical contrivance is added to bring the knobs near together when no current is passing in the primary coil. The induction-coils used are of comparatively small size

M TERQUEM (*Jour. de Phys.*, October) prepares, for the receivers of air pumps, brass plates with a circular groove, in which is put a mastic fusing about 60°. The plate is placed over a vessel of heated water, and when the mastic is fused the receiver is brought down into the groove. When cool, the plate adheres to the jar. These receivers are tubulated, and a caoutchouc stopper in the tubule holds a tube bent at a right angle and provided with a stopcock like those used by M. Carré in his air-pump For experiments with the air-pump several receivers with their plates can be easily prepared beforehand.

M. LIPPMANN points out (*Jour. de Phys.*, October) that full justice has hardly been done to Carnot with reference to his law (in thermodynamics). It seems to have been forgotten that he verified the law directly by experiment, and did not merely (as is found stated in excellent treatises) furnish a demonstration *à priori* based on the indestructibility of heat This is doubtless due to the fact that Carnot's original work has long been exhausted and unobtainable M Lippmann considers that work a mine imperfectly explored.

EXPERIMENTS have been made by M. Heschus of the St Petersburg Physical Society, as to the variations of volume and coefficient of elasticity of palladium and its alloys under the influence of hydrogen absorbed. The alloys contained 25 per cent. of gold, silver, and platinum Wires 500 mm long and 0·4 mm. diameter served successively as cathode in electrolysis of dilute sulphuric acid in a long vertical glass tube, where they were stretched by weights so that their length could be measured directly with a cathetometer The alloy containing silver showed the greatest increase of length, 11·7 mm., palladium-platinum 6 14 mm., pure palladium 5 mm, and palladium-gold only 0 9 mm With a current of six bichromate elements, the elongation, very rapid at first, reached its maximum after nearly an hour The shortening after breaking the current proceeded in a similar way, but less rapidly, *e.g* for palladium wire it was only 2 6 mm after twenty-four hours. Some experiments were made with the aid of a recording apparatus, and they also proved that, contrarily to Graham's opinion, the absorption of hydrogen takes place more quickly than the reverse action, and even when electrolytic oxygen is made to act on the wire (used as anode) M. Heschus made a special delicate apparatus for measuring small variations in the length of wires. With this it was proved, that during the first day the shortening of the wire charged with hydrogen decreases very quickly, about the third day it becomes constant; it again decreases rapidly about the seventh day, then approaches zero asymptotically. This agrees with MM. Troost and Hautefeuille's experiments on the tension of hydrogen of palladium.

A PLUVIOMETER which registers the quantity of rain, and the duration and hour of the fall, is described by S. Grimaldi in *Rivista Scientifico Industriale* for October 15.

IN a recent note to the Vienna Academy, on the relation of the daily and yearly variation of temperature to the eleven-years sun-spot period, Herr Liznar first compares observations of the daily variation at thirteen places (including St. Petersburg, Calcutta, and Hobarton), and finds for all some correspondence with the sun-spot curve. The curve from data for Vienna, Prague, Caslan, Brünn, and Trieste from 1857–70, brought to an average, shows, for the minima of this variation in 1859–60 and in 1870–71, a very good agreement with the corresponding maxima of the sun-spot curve; while the maximum of the variation precedes the minimum of the spots by about two years With regard to the yearly variation of temperature, Dr. Hahn's results for Leipzig are fully confirmed by data from eight other places in Europe, the variation showing a maximum and minimum corresponding to the maximum and minimum of spots.

THE combinations formed by phosphuretted hydrogen with hydrobromic and hydriodic acids have been long known. Its combination with hydrochloric acid has lately been effected by M Ogier (*Jour. de Phys.*, November) by compressing equal volumes of the gases in M. Cailletet's apparatus Compressing about 20 atm. at + 14°, small yellowish bright crystals appear, and with sufficient pressure the two gases disappear entirely (if the mixture have been well made), the tube being covered with a crystalline coat without trace of liquid. If the upper part of the tube be heated with tepid water (+ 20°), the compression produces a liquid layer If the tube be slowly cooled, and 60 or 70 atm. maintained, so as to get only a small layer of liquid, the combination forms slowly in crystalline state. Sudden compression, without external heating, will also produce the liquid. On the other hand, if before there is any deposit of crystals the pressure be relaxed (from 25 atm *e.g*) one perceives not a mist, but small, light, solid flocks, which slowly go down the sides of the tube and disappear. The combination can also be produced under cold without pressure, crystals are formed about − 30° If the compound exist in the gaseous state, it is almost wholly dissociated at ordinary temperature and pressure

AN amplifying barometer has been invented by M. Debrun (*Jour. de Phys.*, November) Suppose a Fortin barometer, in the tube of which the mercury is kept at a constant height The cistern has two other vertical tubes open to the atmosphere, one rising out of the mercury, the other from water over the mercury The variations of the water in the latter are read with the aid of a scale, and they are thirteen and a half times greater than those of the mercury in the other open tube.

RECENT experiments in capillarity by Herr Volkmann (*Ann der Phys.*, No. 10) have led him to the following results —1 The influence (affirmed by Wilhelmj) of curvature of the wall on constants of capillarity cannot be maintained, and is explicable by the supposition of a faulty determination of specific gravity (The arrangement of the index is also objectionable) 2. Observation of the height of rise between parallel plates warrants the assumption of a constant wall-layer, on which the liquid rises. 3. The thickness of the wall-layer in the case of neat's-foot oil and alcohol is found constant for plates and tubes at 0·004 mm. 4. In so far as the results with neat's-foot oil and alcohol may be extended to other wetting liquids, no influence of curvature of the wall on constants of capillarity is demonstrable.

PROF. SILOW of Moscow has studied the magnetism of iron chloride solution by the method of induced currents (*Ann der Phys.* No. 10), and finds that the coefficient of magnetisation is not a constant, but a function of the force of separation. As the latter gradually increases, the former at first increases too, and pretty quickly, but reaches a maximum and then decreases, first quickly, then slowly. The liquid is therefore relegated to the same class of magnetic bodies as iron, steel, or nickel, and the author considers that probably all magnetic bodies show this rising and sinking of the coefficient.

IN a paper which appears in the *Ann. der Phys* (No 10), Herr Hankel gives the chief results of his study of the photo- and thermo-electric properties of fluor-spar. He states, *inter alia*, that the middles of the cube-faces become, in light, negative, the tension decreasing towards the edges, and especially the angles, which often show the opposite polarity. It is the chemical rays that act. The carbon electric light does better than sunlight. Sparks between two Leyden jars give the effects, but the light of Geissler tubes does not. Green Weardale crystals were the most excitable (of the specimens tried) The intensity of the effect generally grows with the depth of the colouring The tensions produced by light do not change to those of opposite sign when the crystal is put and kept in the dark. Crystals long exposed to light are weakened in excitability. A moderate heating (to 130° to 150° C.) exalts the photoelectric effect. As to thermoelectricity, rise of temperature produces tensions of the same sign as illumination does. In cooling, the opposite electricities appear. In many crystals weakly excitable by light, the thermoelectric tensions are greater than the photoelectric (especially in the case of brown-red or brown-violet crystals)

GEOGRAPHICAL NOTES

SOME time back it was publicly stated that Commander Cheyne and his friends intended to apply to the Geographical Society for countenance and support to their plans of Arctic exploration. A deputation accordingly waited on Lord Aberdare, the president, on October 12, and, in pursuance of a suggestion he then made, a statement of Commander Cheyne's plans was lately drawn up by a committee for submission to the Council of the Society This has been considered, and in reply the President and Council regret that the scheme, as explained by the statement, does not commend itself to them as one containing the elements of success and of usefulness, and that, even if it were feasible, the means proposed to be adopted for encountering the great dangers and difficulties necessarily attendant upon such an enterprise, do not appear to them sufficient. We believe the Geographical Society is to take up the subject of Arctic exploration this session An Arctic Committee will be appointed to bring together all that has been done since the last English expedition, to enable the Society to decide what steps they should take.

THE post of honour in this month's issue of the Geographical Society's *Proceedings* is naturally assigned to Mr J Thomson's report of the journey of the East African Expedition, of which we have already given a *résumé*. It is illustrated by a map showing his route, constructed from the explorer's original map and other sources. There is also a useful little map of a route from Kagéi to Tabora, by the Rev C. T Wilson of the Church Missionary Society's Nyanza Mission Capt. A H. Markham's "Visit to the Galapagos Islands in 1880" follows, with some observations by Mr. Osbert Salvin on recent additions to our knowledge of the fauna of the group From the geographical notes we learn that medals and other rewards are to be presented to Mr Thomson's native followers, and that Dr. Kirk is to receive the formal thanks of the Society for the important services he rendered to the East African Expedition. Some interesting extracts from Capt Carter's diary on his fatal march from Karema are next given, with a summary of recent news respecting African exploration The remaining notes deal with M. Mushketof's ascent of the Zarafshan glacier, Russian explorations in Eastern and Western Siberia, surveys in Turkey, and an attempt to explore the affluents of the Rio Purûs.

MR. J BANTING ROGERS has devised and published a game which is likely to be of service not only as a really interesting amusement, but also as a means of acquiring a considerable knowledge of navigation and meteorology It is entitled the game of a "Voyage Round the World," and is played on a large board representing the ocean, suitably divided for counting by knots, and with hazards in the shape of cyclones, collisions, &c, which add excitement to the game The game is played by means of a number of small models of ships of various kinds, and cards in which the number of knots is marked within which the players may move. Logs are kept, watches appointed, and a captain of the watch to record distances, &c. Altogether it will be seen that in Mr Rogers's ingeniously devised game there are great possibilities both of amusement and instruction

TWO Danish Expeditions which have been carrying on scientific exploration in Greenland have returned to Copenhagen. One of them, under Lieut. Hammer, has been continuing the investigations into the movement of the mainland ice into the fjords and the formation of icebergs. In the course of the summer several previously unknown fjords were visited, and the western part of the island of Disko surveyed and mapped. The other expedition, under Lieut. Holm, was to explore several of the large ruins of former settlements in the district of Julianhaab and to obtain information on the population and condition of the east coast. Several extensive ruins were found, which must have been left quite 100 years ago, and of which the present natives know nothing. Among these ruins many objects of ethnological interest were found. The weather during the whole summer was rainy and cloudy; indeed people who have been many years in Greenland never knew of so rainy a summer.

WE believe there is some prospect of Mr. Joseph Thomson being engaged to lead an expedition from Sierra Leone towards Timbuctoo, mainly to establish trading relations between the English Colonies and the interior. It would be a pity should Mr. Thomson be compelled to become a mere trading caravan leader.

MAJOR SERPA PINTO's account of his remarkable journey, which is still unpublished, is to be called "How I crossed Africa," instead of "The King's Rifle."

THE following telegram has been received in St. Petersburg from Col. Prejevalsky:—"Have finished my travel. Rich collections: 2000 birds, many mammals, 1300 species of plants. Will be in St. Petersburg at the beginning of January"

AT the last meeting (November 17) of the Russian Geographical Society, Dr. Piasetzky read an interesting paper on China. He has very closely studied the character of the Chinese, their life, their moral principles, and the education of children. Dr. Piasetzky, who has travelled during several years in China, is the author of a very interesting Russian work in two volumes on that country. the work is illustrated with very good drawings, which represent "types" of Chinese towns, streets, dwellings, market-places, &c. At the same meeting the Society resolved to take part in the next Geographical Congress and Exhibition at Venice

BEFORE proceeding to Paris, as we mentioned last week, MM. Verminck, Zweifel, and Moustier were present at an enthusiastic meeting of the Marseilles Geographical Society, when the President, M. Rabaud, after a eulogistic address, presented them with medals for the part they respectively took in the expedition to the sources of the Niger

LIEUT. E. W PETLEY, of the Marine Survey of India, has lately drawn up some interesting notes on Marmagao (Goa), Portuguese India.

THE new *Bulletin* of the Antwerp Geographical Society contains an account of Mr Andrew Goldie's last journey in New Guinea, and some observations on artesian wells in the Sandwich Islands.

MR. TODD, the Government Astronomer at Adelaide, is to proceed next May to Port Darwin, in the Northern Territory, to determine by telegraph the difference of longitude between that place and Greenwich.

A RECENT telegram from the Austrian traveller Oscar Lenz states that he had reached Medina, Senegal, on November 2. Oscar Lenz penetrated to Timbuctoo from the north, and went thence by Bassikonon, Sokolo, Goumbon, Nioro, and Konniakany to Medina

HERR STIER, director of the Gymnasium in Zerbst, found, a short time ago, a detailed account of Vasco da Gama's second voyage to India It is drawn up by a Dutchman (who accompanied Vasco da Gama), and in his own tongue. Herr Stier has now published a German translation of it.

MR MUNDELLA ON EDUCATION IN SCIENCE

ON Friday last the Textile and Dyeing Departments of the Yorkshire College, Leeds, were formally opened, and at the dinner which followed the Right Hon. A J. Mundella, M.P., Vice-President of the Council, proposed the toast of the occasion:—"Success to Yorkshire College." His remarks in connection therewith are so significant, coming from our *de facto* Minister of Education, that we give them in full

There had not, he commenced by saying, been a more gratified spectator of the proceedings of that day than he was. There had been no one amongst them who had enjoyed more, if so much, the sense of satisfaction—he had almost said of triumph—that he had enjoyed that day Sixteen years ago when he was, like many of those present, a captain in the ranks of industry, he took some interest in the question of the application of science to the industries of this country. His attention had been called to it by the advantages he possessed of seeing what was being done in other countries. He saw the infancy of technical education abroad, and now he stood by its cradle at home. The School of Arts et Métiers in Paris was not by any means a new school, and it had done great things for French industry. There was no one who was acquainted with that school who would not endorse his remarks when he said that it had done marvellous things for French manufactures, and he had learned since he came to Leeds that we had some of its most distinguished scholars in this town He witnessed the beginning of technical instruction in Germany with the erection of the Polytechnic School of Zurich, and when he went to the members of the Chamber of Commerce of which he was

president, and told them what he had seen, the answer was that they had great doubts about the success of the experiment It was thought then that the practical place to give technical instruction and teach the application of science to industry was in the workshops. They had now satisfied themselves, however, that whilst they could not dispense with the practical experience of the workshops, there was something that gave value to that experience. Let them take the art of dyeing for example What was the old system of training in regard to it? The dyer did not then ascertain the properties of the articles with which he had to deal with that skill and accuracy with which the young men of Leeds were ascertaining them to day It used to be a bucketful of this, a shovelful of that, and a handful of the other. But the days of the old rule of thumb were numbered, and on standing at the cradle of the Yorkshire College he stood by the grave of the rule of thumb He had been greatly encouraged this week by his visit to Yorkshire. He came to it somewhat in a state of despondency not however with reference to elementary instruction, for the people of Yorkshire were doing wonders in that way, and in a few years hence this county would compare favourably in that respect with any part of the globe But he had been examining recently, not for the first but the tenth time, what was being done on the Continent in the way of technical education They had opened a good school in Leeds, but they must not flatter themselves They must not believe that the 25,000*l* which his friend Mr Denison had indicated was the sum wanted to complete the work. He had stood in an industrial town of 70,000 inhabitants, in which a single building that had been erected within the past three years solely for teaching science, as applied to industry, had cost 100,000*l*. He had stood in three or four such towns He had examined technical institutions in France, in Switzerland, and in the south and north and centre of Germany, and all he could say was, that not having examined these institutions critically for five years, he stood amazed and almost aghast at what he beheld He came home feeling that in the countries he had mentioned they had found the weak place in our armour, and had wounded us in our tender part, but what he had seen in Yorkshire within the last week had given him renewed confidence and courage He found, in addition to this splendid institution which had been opened to-day, that in the little town of Keighley—a very splendid little place—they were going to spend 5000*l* in a weaving-school, that the Clothworkers' Company of London were going to assist Bradford also, and he was told that in Huddersfield they had got 15,000*l* or 16,000*l*, that they had no longer to teach elementary instruction in their night-classes, but wanted to give scientific and technical instruction to their workmen, and wanted a school for Huddersfield Yesterday he stood by the grave of an eminent Yorkshireman who had done noble service to the teaching of science in Yorkshire—his friend Mr Mark Firth Would they not see that Yorkshire had many as worthy sons as Mr. Firth? Surely he was not the last man that would endow a college for science teaching There were men, he hoped, within the sound of his voice who would perpetuate their memory, and show some gratitude to the industry that had made them wealthy by endowing another wing of the College like the one they had seen to-day They must not believe that this was mere amateur work. This was not science teaching merely for the sake of scientific research, for arriving at scientific truth, or for giving intellectual culture. Those nations on the Continent who had produced such magnificent buildings, machinery, and apparatus to conduct this work were not doing so from sentimental reasons They were not doing it with the object simply of endowing scientific research, or to make great progress in any particular branch of science Their object was a very prosaic and a very practical one, and very full of self-interest. What they meant was to get industrial strength, which they believed was the real source of the wealth of their nation. The Yorkshire College was founded to supply instruction in those sciences which were applicable to the industrial arts. He might say as the result of his recent observations that France and Germany were conducting as active a competition with each other in this matter of arming for the industrial fight as any of the nations of the Continent of Europe were in their military armaments with a view to any catastrophe in future. But this was not a case in which Englishmen could look on with benevolent neutrality, because after all in this international fight they could not stand aloof, they could not remain neutral, for the blow, whenever it fell, would fall upon them. Rely upon it the success of the Science College of Yorkshire meant the success of Yorkshire itself They possessed great natural resources for which their Continental neighbours envied them They had in their immediate neighbourhood, in the mine, the coal and iron, they had in their people great vigour, great energy, and great inventive capacity; and they had also their old prestige. They had amongst them men of great wealth There was his friend Mr. Denison ready to provide them capital very freely—at a very moderate rate England, after all, was the great emporium as a depôt market for nearly all the raw material of the world To London came that Australian wool so many thousand bales of which were exported to their neighbours on the other side of the water, and then came back to them in a finished state for the consumption of their own population He was speaking from actual knowledge when he said that there was an enormous increase in the manufacture of dressed goods that could be well made in Yorkshire, that could be produced and sold in Yorkshire, and that were yet made abroad, but ought to be made at home He believed the step they were taking that day in opening the College was the very way to create that employment at home which at present was too much done abroad It had been said that the country gentlemen ought to assist in this movement. Lord Frederick Cavendish had come from a great and honourable house, and they all rejoiced in the wealth, ability, business capacity, sagacity, and liberality of that house. But what was it that had made these great houses and England wealthy? Was it not the value which had been added to the land by the success of the great manufactures? The success of the great houses of England was bound up in the success of the Yorkshire College and of other colleges like it Thus to the success of their manufactures they must look for the continued greatness of England in its dealings with nations in the future Why, they had but the same area of land now as they had when their population was only 10,000,000. They had 25,000,000 of people in England and Wales now, and they were multiplying at a rate which would soon double this number What was it that was to feed all these people but the success of their manufactures? If they were to hold their own they must not lose a point, they must not neglect a single opportunity, they must not rest content on their old prestige, but they must, as Englishmen, look the difficulty in the face, and, where weakness existed, strengthen themselves, and this weakness was to be found entirely in the question of education, which they had too long neglected. In asking them to drink success to the Yorkshire College, he was asking them practically to drink to themselves. If they wished perfect freedom to carry on this work, he was quite of the opinion of Lord Frederick Cavendish that they must adopt the newest methods—to be untrammelled in their efforts, to carry on the College by themselves, and in that way in which Englishmen had been accustomed to do their work

THE ROYAL SOCIETY—ADDRESS OF THE PRESIDENT[1]

II.

THE aspect of spectrum analysis has become much complicated by two sets of facts. First, the increased dispersion, the improved definition, the enlarged electrical power at our command, and, above all, the substitution of photography for eye observations, have revealed to us an almost overwhelming array of lines belonging to each substance And, secondly, the same means have shown that many substances present different spectra when in different molecular states. These complications have led spectroscopists to seek some relief in theories of simplification Lecoq de Boisbaudran, Stoney, Soret, and others have suggested that many of the lines, or groups of lines, may be regarded as the harmonics of a fundamental vibration, and they have shown that in certain cases this view will account for the phenomena observed Professors Liveing and Dewar have contributed largely to the subject by their observations on the reversed lines Looking in another direction, Mr. Lockyer considers that in increased temperature we have the means not only of resolving compound bodies into their elements, but even of dissociating bodies hitherto regarded as elementary into still more simple substances There still remain serious difficulties connected with Mr. Lockyer's views, but it is to be hoped that his indefatigable energy will in some way or other ultimately overcome them

The outlying parts of the spectrum, beyond the visible range,

[1] Address of William Spottiswoode, D C L, LL D, the President, delivered at the Anniversary Meeting of the Royal Society on Tuesday, November 30, 1880. Continued from p 114

must always be a subject of interest; and while MM. Cornu and Mascart, and others, have extended our knowledge of the ultra violet end, Major Abney has opened out to us a new region beyond the red. Lord Rayleigh and others before him have however proved that there must be a limit at the least refrangible end of the spectrum. Prof. Stokes, long since, noticed the difference in length between the spectrum of the sun and that of the electric arc, and M Cornu has recently shown by observations at elevated stations that the great rapidity of atmospheric absortion must preclude the hope of any great extension of the solar spectrum toward the more refrangible end.

The striking advances made in electricity during the last few years, and marked by, amongst other things, the inventions of the telephone and the microphone, have been followed by a step not less daring in its conception, nor less successful in its execution, I allude, of course, to the photophone, the result of the researches of Mr. Graham Bell and Mr. Sumner Tainter. The principle of this instrument is already known. A powerful beam of light is first thrown upon a flexible mirror, the curvature of which is modified through vibrations set up in it by the human voice. The reflected beam is then received by a selenium "cell" forming part of an electric circuit. The intensity of the light so received, and with it the resistance in the circuit due to the selenium, varies with the varying curvature of the flexible mirror. A large parabolic mirror is used at the distant station to concentrate the light on the selenium "cell"; and a telephone in the circuit reproduces the variations in the form of sound

Mr. Bell has however also shown that rays from the sun, or an electric lamp, when rendered intermittent by any convenient means, will set up in a plate of almost any substance vibrations corresponding to the intermittence. The substances as yet tried are: metals of various kinds, wood, india-rubber, ebonite, &c., and among them zinc appears to be one of the best suited for the purpose. This result, which is independent of any electric action, is perhaps due to heat rather than to light.

In these, as in many other issues of scientific research, we can hardly fail to be impressed by the almost inexhaustible resources which lie ready to hand, if we only knew how to use them, for the interpretation of nature or for the practical purposes of mankind.

During the past year Prof. Hughes employed his induction balance for the detection of very minute impurities in small masses of gold. Mr. Preece also has shown how slight increments of temperature in fine wires transmitting telephonic currents of electricity will suffice to reproduce sonorous vibrations, and even articulate speech, at a distant station by their influence on thin platinum wires only six inches in length.

Mr. Stroh has shown that, at the point of contact of two metals carrying strong electric currents, adhesion takes place, varying with the nature of the surfaces in contact, and that many of the effects at points of contact, previously attributed to induction, may be due to the peculiar action now for the first time brought under notice.

It is worthy of record that two Atlantic cables have been successfully laid during the present year; but that the operation has become so much a matter of course, that its occurrence has attracted little public attention. Two cables, each of more than 500 miles in length, have been laid across the Mediterranean, and the Cape Colony has been placed in telegraphic communication with this country by a cable of not less than 4400 miles.

Constant attention is paid in the General Post Office to the introduction of improved methods for the furtherance of the telegraphic communication throughout the country.

Steady progress has been made in bringing the electric light into practical use. The illumination of the Albert Dock of the London and St. Katherine's Dock Company, the Liverpool Street Station of the Great Eastern Railway, the St. Enoch's Station of the Glasgow and South Western Railway, and last, but not least, that of the reading-room of the British Museum, have become accomplished facts; while the City authorities have decided to extend the use of this light over various thoroughfares under their control. The subdivision of the light for domestic purposes is a problem which appears to have found a solution in the incandescent carbon lamp of Mr. Swan. Besides this, Mr. J. H. Gordon has devised, for the same purpose, a very ingenious application of rapid sparks from alternating machines, such as that of De Meritens, to produce incandescence in refractory metals. Lamps constructed on this principle completely fulfil the conditions of subdivision, but some difficulties of detail still retard their adoption for general use. There is, however, every reason to hope that the experience already gained, and the intelligence at present brought to bear upon it, will before long supply us with more than one form of domestic light.

The chief question of interest which has occupied the attention of the Iron and Steel Institute has been the adaptation of the "basic" process to the production of steel from pig metal containing a considerable percentage of phosphorus. Hitherto only pure hæmatite and spathic ironstones have been used for the production of steel; but it has now been shown that, by the employment of basic linings and basic slags, the metal is almost completely cleared of its phosphorus, and that steel of good quality may be produced from inferior ore.

The Conference on Lightning-Conductors, composed of delegates from the Royal Institute of British Architects, the Society of Telegraph Engineers, the Physical Society, and the Meteorological Council, is steadily pursuing its labours. A large mass of facts has been accumulated, several leading questions have been decided; and it is hoped that, in the course of the coming year, the Report of the Conference will be issued

One of the most interesting, and at the same time useful, applications of the dynamo-machines, is that of transmitting mechanical power to spots, or under circumstances, where the ordinary appliances cannot be conveniently used. Their principle will doubtless by degrees extend itself over a wide range of industry, especially in localities where water-power is abundant. A very remarkable instance of such adaptations will be found in Dr. Werner Siemens's propulsion of railway carriages in Berlin.

Our Fellow, Dr. C. W. Siemens in London, and M. De Méritens in Paris, have demonstrated the use of the high temperature of the electric arc in fusing refractory metals. The method of operation, while peculiarly convenient for laboratory purposes, and for demonstration, promises to be capable of extension, even to the large demands of commerce and manufacture.

I should not, moreover, omit mention of the very beautiful experiments by Dr. C. W. Siemens on the effect of the electric light on the growth of plants, on the opening of flowers, and on the ripening of fruit On this subject we hope to hear more hereafter. He has already commenced a fresh series of experiments, and contemplates continuing them during the coming winter.

I am not sure how far the fact is known to the Fellows of the Royal Society that the Society of Telegraph Engineers has thrown open to the scientific world a remarkable collection of books on electrical science, collected by our late Fellow, Sir Francis Ronalds, and bequeathed by him to that Society The catalogue, compiled by the collector, is a monument of concentrated and well-directed labour.

As regards the Transit of Venus in 1874, the printing of the observations is complete for the two groups of stations in the Sandwich Islands and Egypt, and that for others is in progress.

Preparations are already being made with a view to the observation of the Transit of Venus in 1882. As a preliminary step for this operation, as well as for general purposes, it had been decided that the longitude of the Cape Observatory should be definitively determined by telegraphic connection with Aden, which place is already telegraphically referred to Greenwich; and, notwithstanding a temporary interruption on the land line, Capetown-Durban, it may be hoped that the connection will be effected at no distant period. Mr. Gill is prepared to undertake the main share of the work. With the same objects in view, on the urgent representation of the Astronomer-Royal, it has also been determined to connect one of the Australian Observatories with Greenwich, through Madras, the longitude of which is well known; and this operation will be very much facilitated by the share which Mr. Todd, Government Astronomer and Superintendent of Telegraphs at Adelaide, would be prepared to take in it under the auspices of his Government. The eastern boundary of the Colony having been defined by Imperial Act as the 141st meridian, a wish has been expressed officially for the accurate connection of Adelaide with Greenwich, independently of the Transit of Venus.

The Astronomer-Royal has explained in detail the preparations which he considers necessary, so far at least as this country is concerned, for the effective observation of the transit, and he has introduced several alterations in the plan which he had formerly

suggested. The experience of the transit of 1874 points to the desirability of sacrificing something in the magnitude of the parallax-factor for the sake of securing a higher elevation of the sun; thus, for retarded ingress, Sir George Airy had at first proposed to refer principally to the coasts of the Canadian Dominion and the United States of North America, where the sun's elevation is from 15° to 18°, he now proposes to substitute for this the whole chain of West India Islands, from the eastern extremity of Cuba to Barbadoes, or stations on the neighbouring continent of Central America. Bermuda is also included as a favourable point for observation. Most, if not all, of the longitudes required have been determined with great precision by the Hydrographic Department of the United States. For ingress accelerated, Sir George Airy relies entirely upon stations in the Cape Colony. For the accelerated egress, all the stations suggested for ingress retarded will be available. For egress retarded, although the fixed Observatories at Melbourne and Sydney will contribute to the observation of the phenomenon, they will have the sun at a somewhat low elevation (10—14°), it is thereby proposed to rely mainly upon New Zealand, with which we are in telegraphic communication *viâ* Sydney. Considerable correspondence has taken place on the subject of Australian longitude, and it is expected that the necessary steps to effect the connection of one of the Observatories, probably Adelaide, with Madras, will be taken early in the ensuing year.

Sir G. B. Airy has completed the laborious calculations in his Numerical Lunar Theory, from which the corrections to the coefficients of Delaunay's Lunar Theory are to be deduced, and in connection with this work he has made an investigation of the value of the Moon's Secular Acceleration, for which he finally obtained the value 5″·477, thus confirming the results obtained by Prof. Adams, and subsequently by M. Delaunay. On this important question, Prof. Adams has also published an investigation (*Monthly Notices*, vol. xl. Nos. 6, 7, 8 and 9).

A new determination of the Physical Libration of the Moon from a large number of lunar photographs taken with the De La Rue reflector at the Oxford University Observatory has been recently made by Prof. Pritchard, the result being to indicate the existence of a small rotational inequality.

Messrs. J. Campbell and Neison have made use of the Greenwich Observations, 1862 to 1876, to determine the Lunar Parallactic Inequality, from which they deduce for the value of the Solar Parallax, 8″·778, or 8″·848, according as the existence of a forty-five year inequality, apparently indicated by the observations, is admitted or not (*Monthly Notices*, vol. xl. Nos. 7 and 8). The Sun's Parallax has also been determined by Mr. Downing, from N.P.D. observations of Mars at Leyden and Melbourne, in 1877. The value thus found is 8″·96 (*Astronomische Nachrichten*, No. 2288).

In continuation of his researches on tidal retardation from the action of a satellite on a viscous planet, Mr. G. H. Darwin has investigated the secular changes in the orbit of a satellite, deducing the early history of the earth and moon from the time when they were initially in contact, each revolving in the same period of from two to four hours. This leads to the suggestion that the moon was produced by the rupture of the primæval planet. In another memoir, Mr. G. H. Darwin gives analytical expressions for the history of a planet and a single satellite (*Phil. Trans.*, 1879, *Proc.* Roy. Soc., Nos. 200 and 202).

An important work in connexion with the United States Northern Boundary Commission has been published by Mr. Lewis Boss, on the Declination of Fixed Stars. The systematic corrections to some seventy catalogues have been discussed, and, from the mean of the whole, standard declinations of 500 stars have been deduced.

Dr. Gould's "Uranometria Argentina" and M. Houzeau's "Uranométrie Générale," are of especial value as giving important information on the brightness and distribution of the stars in the southern hemisphere.

Interesting results as to the diameters of satellites have been obtained by Prof. Pickering from photometric observations, on the assumption that their albedos do not differ greatly from those of their respective primaries. (*Annals*, Harvard College Observatory, vol. xi.) He has further investigated, on somewhat similar principles, the dimensions of the fixed stars, with especial reference to binaries and variables of the Algol type (*Proc.* Amer. Acad., vol. xvi.). Prof. Pickering has also commenced a photometric survey of the heavens, in which the brightness of every star visible to the naked eye is to be determined. He has further undertaken a search for planetary nebulæ by a new method, in which, by the use of a direct-vision prism in front of the eyepiece, the nebula is at once detected by its monochromatic spectrum, focussing a point of light instead of a coloured line as in the case of a star. About a hundred thousand stars have been examined, and four new planetary nebulæ have been detected. (*American Journal of Science*, October, 1880.)

From the grouping of the aphelia of certain periodic comets Prof. G. Forbes has inferred the existence of two ultra-Neptunian planets, and has indicated their approximate positions (*Trans.* Roy. Soc., Edinburgh.) Mr. D. P. Todd has deduced from the perturbation of Uranus a position for an ultra-Neptunian planet closely agreeing with that found by Prof. G. Forbes. So far, the search for the hypothetical planet with the 26-inch Washington refractor has been unsuccessful. (*American Journal of Science*, September, 1880.)

Prof. Bredichin's researches on the tails of comets have led him to the classification of these appendages according to the value of the solar repulsive force which would have generated them. Having discussed the forms of the tails of thirty-three comets, he finds that they belong to three types, corresponding respectively to repulsive forces 11, 1·4 and 0·3 (the sun's gravitation being taken as 1), and adopting Zollner's hypothesis of a repulsive force, due to electricity and inversely proportional to the specific gravity, he infers that the tails of the three types are composed respectively of hydrogen, carbon, and iron. In the case of the second and third types other elements of nearly the same atomic weight may replace or be mixed with the carbon and iron, and in such a comet as Donati's a number of substances may be mixed in the tail, which will consequently spread out in the plane of the orbit. The first type composed of hydrogen will always remain separated from the others. (*Annales* de l'Observatoire de Moscou, vols. iii. vi.)

The appearance, at the beginning of this year, of a great comet in the southern hemisphere, recalling by the length of its tail and the smallness of its head the remarkable comet of 1843, has excited great interest, more especially as it was found that the orbits of the two comets were sensibly the same. The observations of the comet of 1843, however, do not appear to be compatible with so short a period as thirty-seven years, and Prof. Oppolzer has shown that the action of a resisting medium would not meet the case (*Astronomische Nachrichten*, Nos. 2314, 2315). Under these circumstances Prof. D. Kirkwood has suggested that the two bodies may be fragments of one original comet, viz., that of 370 B.C., which is said to have separated into two parts like Biela's comet (*Observatory*, No. 43). Five other comets (including Faye's periodical comet) have been discovered this year, but two of them were lost through cloudy weather before a second observation could be obtained.

In astronomical physics Mr. Huggins has obtained photographs of stellar spectra, which establish the existence of a remarkable group of nine bands in the ultra-violet, probably due to hydrogen, and further lead him to an arrangement of the stars in a continuous series according to the breadth and marginal difference of the typical lines, particularly of the K line. Mr. Lockyer continues his researches on dissociation, as indicated in solar outbursts, and in connection with this work is engaged on a systematic observation of the spectra of sun spots. At the request of the Committee on Solar Physics, corresponding observations are being made at Greenwich.

From the series of Greenwich photographs of the sun, 1874—1879, the mean heliographic latitude of spots and mean distance from the sun's equator, have been deduced for each rotation and for each year ("Greenwich Spectroscopic and Photographic Results," 1879).

A fine 36-inch silver-on-glass reflector has been recently constructed by Mr. Common, and with this instrument he has obtained photographs of Jupiter, showing the red spot, and of the satellites (*Observatory*, No. 34).

At the outset of an undertaking one figures to oneself in imagination what may be done; towards the close of it one sees in actual fact what has been done. In commencing this address I had hoped to say something of the progress of mathematics; before bringing it to a conclusion I find my space filled and my time exhausted. How far the good intentions of this year may be realised in the next, cannot yet be seen; but the difficulties of a task do not always diminish the fascination of making an attempt.

THE ROYAL SOCIETY MEDALS

AT the conclusion of his anniversary address on Tuesday last week, the President, Mr Spottiswoode, delivered the medals which have been awarded this year, and in doing so spoke as follows :—

The Copley Medal has been awarded to Prof James Joseph Sylvester, F R.S. His extensive and profound researches in pure mathematics, especially his contributions to the Theory of Invariants and Covariants, to the Theory of Numbers, and to Modern Geometry, may be regarded as fully establishing Mr Sylvester's claim to the award of the Copley Medal.

One Royal Medal has been awarded to Prof Joseph Lister, F R S Mr Lister's claims to the honour of a Royal Medal are based upon his numerous and valuable contributions to physiological and biological science during the last thirty years

By permission of its author, the Fellow of the Society best qualified, by his own extensive researches on the germ theory, to form a judgment, I quote the following account of Prof Lister's work and achievements .—

"In 1836 and 1837 it was proved independently by Cagniard de la Tour and Schwann, that vinous fermentation was due to the growth and multiplication of a microscopic plant At the same time Schwann described experiments which illustrated and explained the conditions, now well known, by which flesh may be preserved from putrefaction But Schwann's researches were overshadowed by the views of accepted authorities, and they continued so up to the publication of Pasteur's investigations. From this point forward the view gained ground that putrefaction is the work of floating microscopic organisms ; and that if air be thoroughly cleansed of its suspended particles, neither its oxygen, nor any other gaseous constituent, is competent to provoke either fermentation or putrefaction.

"Condensed into a single sentence, the merit of Mr Lister consists in the generalisation, to living matter, of the results obtained by Schwann and Pasteur with dead matter. He began with cases of compound fracture and with abscesses In simple fracture the wound is internal, the uninjured skin forming a protecting envelope. Here nature works the cure after the proper setting of the injured parts In compound fracture, on the other hand, the wound extends to the surface, where it comes in contact with the air, and here the operator can never be sure that the most consummate skill will not be neutralised by subsequent putrefaction.

"In the earliest of his published communications Mr. Lister clearly enunciates, and illustrates by cases of a very impressive character, the scientific principles upon which the antiseptic system rests He refers to the researches of Pasteur, and shows their bearing upon surgery He points to the representative fact, then known but unexplained, that when a lung is wounded by a fractured rib, though the blood is copiously mixed with air, no inflammatory disturbance supervenes, while an external wound penetrating the chest, if it remains open, infallibly causes dangerous suppurative pleurisy. In the latter case the blood and serum are decomposed by the microscopic progeny of the germs which enter with the air; in the former case the air is filtered in the bronchial tubes, and all solid particles are arrested Three years subsequently this inference of Prof Lister was shown to be capable of experimental demonstration

"After enunciating the theoretic views which guided him, he thus expresses himself in his first paper —

"'Applying these principles to the treatment of compound fracture, bearing in mind that it is from the vitality of the atmospheric particles that all the mischief arises, it appears that all that is requisite is to dress the wound with some material capable of killing these sep ic germs, provided that any substance can be found reliable for this purpose, yet not too potent as a caustic'

"This is the thesis to the illustration and defence of which Prof. Lister has devoted himself for the last thirteen years. His thoughts and practice during this time have been in a state of growth. His insight has been progressive, and the improvement of experimental methods founded on that insight incessant. By contributions of a purely scientific character, which stamp their author as an accomplished experimenter, he has materially augmented our knowledge of the most minute forms of life. The titles of his papers indicate the direction of his labours from time to time; but they give no notion of the difficulties which he has encountered, and successfully overcome. He performs, without dread of evil consequences, the most dangerous operations He ventures fearlessly upon treatment which, prior to the introduction of his system, would have been regarded as no less than criminal. In the Glasgow Royal Infirmary, when wards adjacent to his had to be abandoned, he operated with success in an atmosphere of deadly infectiveness. Vividly realising the character and habits of the 'invisible enemy' with which he has to cope, his precautions are minute and severe. This demand for exactitude of manipulation has rendered the acceptance of the Antiseptic System slower than it would otherwise have been, but a clear theoretic conception has this value among others it renders pleasant a minuteness of precaution which would be intolerable were its reasons unknown.

"The operative surgeons of our day have raised their art to the highest pitch of efficiency. Their skill and daring are alike marvellous Mr Lister urges an extension of this skill from the operation to the subsequent treatment, contending that every surgeon ought to be so convinced of the greatness of the benefits within his reach as to be induced to devote to the dressing of wounds the same kind of thought and pains which he now devotes to the planning and execution of an operation. His impressive earnestness, his clearness of exposition; his philosophic grasp of the principles on which his practice is founded—above all his demonstrated success—have borne their natural fruit in securing for him the recognition and esteem of the best intellects of the age.

"In a letter addressed to the writer on the 29th of September, 1880, Prof Helmholtz expresses himself thus .—

"'Prof Lister ist als einer der hervorragendsten Wohlthäter der Menschheit zu betrachten, und als eines der glänzendsten Beispiele, wie segensreich scheinbar minutiöse und abstruse wissenschaftliche Untersuchungen, wie die über di Erzeugung mikroskopischer Organismen, werden können, wenn sie von einem Manne von umfassendem geistigen Gesichtskreise aufgenommen werden'"

"In a letter dated October 1st, 1880, Prof. Du Bois Raymond writes —

"'The period of bloody warfare through which we passed not long ago, just when Prof Lister's methods were matured enough to be freely used even on the battlefield, has of course contributed to render his name popular throughout Germany, nay, to make it a household word in many homes We use the word 'listern' as a verb to designate the use of the carbol-spray while bandaging a wound. I do not hesitate to proclaim Lister the greatest benefactor of mankind since Jenner's wonderful discovery—far superior, indeed, to Jackson and Simpson; because, whatever may be the dread of pain and the blessing of being spared it, in Lister's invention health and life itself are concerned, as in hardly any other medical discovery except vaccination. Moreover, the general ideas which have led to Prof Lister's conception stamp his work with a peculiarly scientific character'

"In a letter dated from Vevey on the 10th of this month, Prof. Klebs of Prague, himself a distinguished worker in this field, expresses in the strongest terms his admiration of the profound philosophical intuition and practical success of Mr. Lister, as having not only reformed the whole art of surgery, but given a new impulse to medical science generally Prof. Klebs's interpretation of the opposition encountered for a time by Mr. Lister is worthy of mention He ascribes it to the high standard attained by British surgery before the time of Lister. 'The operators,' he says, 'that work under the best hygienic conditions will not feel so acutely as others do the necessity of disinfecting wounds. But the good results of the former British surgery are now surpassed by the new method, which is accepted at the present time by the whole world.'

"Such testimonies might be multiplied to any extent. The foregoing are the answers received from the only three gentlemen who have been requested to express an opinion as to the merits of Mr. Lister."

The second Royal Medal has been awarded to Capt Andrew Noble, late R.A, F.R.S. Capt. Noble is joint author with Prof. Abel of the "Researches on Explosives," *Phil Trans*, 1875, which, in combination with other labours in the same field, procured for Prof. Abel the honour of the Royal Medal in 1879 To Prof. Abel is due mainly the chemical part of these investigations, to Capt. Noble the mechanical and mathematical part. Each is a complement of the other, but it

may be safely affirmed that they could not have been presented to the world in the form in which they appear without the co-operation of his remarkable union of technical knowledge and mastery of mathematical analysis with the chemical science of Prof. Abel. His beautiful invention of the Chronoscope, an instrument constructed by him at great cost, by which intervals of time as small as the one-millionth part of a second can be measured, has been of indispensable value in these researches He is the author of papers which have been translated into most European languages on subjects of gunnery and gunpowder, he is perhaps the highest authority we possess on the higher branches of artillery science, and the best known on the Continent His great talents and attainments are not more conspicuous than his singular modesty and his indefatigable industry. He has been engaged on these subjects about twenty years, having published the first experiments in this country with Navez' electroballistic apparatus, in 1862

The Rumford Medal has been awarded to Dr William Huggins, F R.S. In 1866 a Royal Medal was awarded to Dr. Huggins for his important researches. Since that time he has been continually engaged in prosecuting the subject of celestial spectroscopy, both in the departments in which he had already done so much, and in others of its branches. One subject of Dr Huggins' researches relates to the determination of the radial component of the velocity of the heavenly bodies relatively to our earth, by means of the alteration of the refrangibility of certain definite kinds of light which they emit, or which are stopped by their atmospheres The smallness of the alteration corresponding to a relative velocity comparable with the velocity of the earth in its orbit makes the determination a matter of extreme delicacy. But as early as 1868 he had obtained such trustworthy determinations that he was able to announce before the Royal Society in that year that Sirius was receding from our solar system with a velocity of about 29 94 miles per second.

In a paper presented to the Royal Society in 1872 he has given the results obtained for a large number of stars, and has shown that some are receding and some approaching, and that there seems to be a balance of recession in those parts of the heavens, from which we have reason, from the observed proper motions, which of course can only be transversal, to conclude that the solar system is receding, and a balance in favour of approach in the opposite direction, while yet it does not appear that the motion of the solar system would alone account for the whole of the proper motions of the stars in a radial direction

The same inquiry was extended to the nebulæ, the spectrum of which consists of bright lines, and in this case it presented greater difficulties As those nebular lines which appear pretty certainly to be identifiable with hydrogen are too faint to be employed in the investigation, and the others are not at present identified with those of any known element or compound, he was obliged to avail himself of a coincidence between the brightest nebular line and a line of lead But as the coincidence is probably merely fortuitous, the results give only the *differences* of approach or recess of different nebulæ. The observations seem to show that, so far as has been observed, the nebulæ are objects of greater fixity as regards motion in space, than the stars

The other subject to which Dr. Huggins has more particularly devoted himself of late, is the mapping of the photographic spectra of stars. This was a research of great delicacy, partly on account of the small quantity of light at the disposal of the observer, partly from the great accuracy with which the comparison had to be made with the spectra of known substances, in order that satisfactory conclusions should be deducible as to the presence or absence of such or such substances in the stars. The results obtained led to a remarkable division of the stars into two great classes, naturally with transition cases, namely, white stars, which showed a group of twelve dark lines belonging, apparently, to the same substance, probably hydrogen, and the group of stars, of which our own sun may be taken as a type.

Besides the researches already mentioned, other papers have been presented by Dr. Huggins to the Royal Society, on the spectra of comets, on the spectrum of Uranus; and in particular one in which he showed that it was possible to detect the heat of the stars, and has given the results obtained for several.

The Davy Medal has been awarded to Prof. Charles Friedel, Member of the Institute of France.

From 1856 to the present time the investigations of M Charles Friedel, ranging over widely-remote fields of chemical inquiry, have been continuous, numerous, and important. Mineralogical, theoretical, and general chemistry are indebted to him for many valuable contributions, but it is in the department of so-called organic chemistry that he has more especially laboured, and herein he has done much to assist in breaking down the barriers at one time regarded as impassably isolating the chemistry of carbon compounds.

Among the subjects of M Friedel's successful work may be mentioned more particularly the chemistry of the 3-carbon family of organic bodies, to which belong propionic acid, lactic acid, glycerine, propylene, and acetone. The establishment of the constitution of lactic acid and of acetone, with the determination of the relationships to one another of the various, and in many cases isomeric, members of this large family, constituted for a long time one of the most fiercely-contested, as it was, and is, one of the most fundamental problems of organic chemistry In the labours effecting the satisfactory solution of this problem M Friedel bore a large share.

Passing to another branch of investigation, M. Friedel, partly by himself, but largely in conjunction in some parts of the work with Mr J M Crafts, and in other parts with M A. Ladenburg, made out, or confirmed in a very striking manner, the analogy subsisting between the modes of combination of carbon and of silicon, the most characteristic elements of the organic and inorganic kingdoms respectively.

To mention but one more subject of M Friedel's research, he has, in conjunction with Mr J M. Crafts, made out and defined a simple method of wide application for effecting the synthesis of organic compounds. This method consists in bringing together a hydrocarbon and an organic chloride in presence of chloride of aluminum, whereby the residues of the two compounds enter into combination to form a more complex, frequently a highly complex, body Independently of its utility, this process of synthesis is of remarkable interest from the part taken in it by the chloride of aluminum, which, though essential to the reaction, is found unaltered at the end, and seems to act by suffering continuously, little by little, a correlative transformation and regeneration

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD —The statutes made by the new Commissioners for the different colleges are appearing in their final shape. The statutes of six colleges are already printed and in the hands of Members of Convocation. They resemble each other closely in several respects Ordinary Fellows are to be elected by examination, all the branches of learning recognised in the final schools of the University being taken from time to time as the subject of examination. These Fellowships are tenable for seven years Tutorial Fellows are elected without examination, but the colleges may require two years' college work from an ordinary Fellow, having given notice of such requirement before the examination The colleges may elect persons distinguished in literary or scientific work to Fellowships tenable for a term of years, during which the Fellows shall devote themselves to a definite research specified in the resolution appointing them

Several meetings of the Professors and College Tutors engaged in teaching different branches of Physics in the University have been held during the last fortnight at the instance of Prof. Clifton. The object was to prepare a scheme of lectures for next term, such that the lecturers would cover most of the ground without clashing with each other or with the lecturers in other branches of science It may be mentioned that this is the first time such an arrangement has been arrived at in the Natural Science School at Oxford The following plan of lectures has been agreed upon for next Lent Term —

Optics (treated Mathematically), Prof Price, Tuesday, Thursday, and Saturday, at 12; Magnetism (treated experimentally), Prof Clifton, Wednesday and Saturday, at 12, Practical Physics, Prof. Clifton, Mr. Stocker, Mr. Jones, daily, 11 a.m. to 4 p m Thermodynamics and Electrodynamics (treated mathematically), Mr. Baynes, Monday, Wednesday, and Friday, at 10, Electrostatics (treated mathematically), Mr. Hayes, Saturday at 11; Elementary Mechanics (treated experimentally), Mr. Stocker, Monday and Wednesday, at 10; Problems in Elementary Mechanics and Physics, Mr. Jones, Friday, at 10; Elementary Physics (treated experimentally), Mr. Dixon, Monday, Wednes-

day, and Friday, at 11. The last three courses of lectures are intended to meet the requirements of candidates for the Preliminary Honour Examination.

SOCIETIES AND ACADEMIES

London

Geological Society, November 17.—Robert Etheridge, F.R.S., president, in the chair —Prof. Joseph Henry Thompson, Auckland, New Zealand, was elected a Fellow of the Society —The President called attention to the portrait of Dr. William Smith, presented to the Society by his grand-nephew, Mr. W. Smith of Cheltenham, which was then suspended behind the chair, and expressed his great satisfaction at this most interesting picture being in possession of the Society. Mr. W. W Smyth expressed the satisfaction which all must feel in possessing a genuine relic of this eminent stratigraphical geologist Now this one, which had been so liberally presented to the Society, was a most indubitable portrait of the most conspicuous founder of English geology. That portrait was painted by M. Fouran in 1837, and was certainly an admirable likeness. The Society was deeply indebted to the donor, Mr. W Smith, the cousin of the valued Prof. Phillips. The portrait now hanging on the wall was engraved in Prof. Phillips' "Life" of his uncle. He proposed a hearty vote of thanks to the donor Mr. Evans rose with great pleasure to second the vote of thanks proposed by Mr. Warington Smyth. The portrait was indeed replete with interest, not only to English geologists, but to all geologists in the world. An additional interest attaching to the portrait was that we had the whole history of it from Dr. Smith's own hand, an extract from which Mr Evans read The portrait was an admirable one. He hoped that in the future Mr. Smith's example would be followed, and that we should see many other portraits of eminent geologists on the Society's walls. The Society was also deeply indebted to the president for the interest which he had taken in the matter. The vote of thanks was carried by acclamation.—The following communications were read :—On abnormal geological deposits in the Bristol district, by Charles Moore, F G S.—Interglacial deposits of West Cumberland and North Lancashire, by J. D. Kendall, C.E., F G S

Royal Microscopical Society, November 10.—Dr. Beale, F R S, president, in the chair —Photographs of *P angulatum* and *Frustulia saxonica* were exhibited by Herr O. Brandt, the Tolles-Blackham and eight other microscopes by Mr Crisp, "Calotte" diaphragms by Mr. Swift; Hyde's illuminator by Mr J Mayall, jun.; and Dr Carpenter, C B., described Wale's "working microscope" with Iris diaphragm, which he highly commended as combining many novel and excellent points for a student's microscope.—Mr. Lettsom described Abbe's "stereoscopic ocular," and Dr Maddox his apparatus for collecting particles from the air.—Notes were read on monobromide of naphthaline (for mounting diatoms to increase their "index of visibility").—On ebonite for microscopical appliances, and on aperture exceeding 180° in air, also papers by Mr Stewart on the echinometridæ, and by Dr. Royston Pigott on testing object glasses.

Paris

Academy of Sciences, November 22.—M. Edm Becquerel in the chair.—The following papers were read:—Meridian observations of small planets at the Greenwich and Paris Observatories, communicated by M. Mouchez —The thermal springs of the coast chain of Venezuela (South America), by M. Boussingault. The most important are those of Onoto (alt. 696 m.), Mariara (533m), and Trincheras, near Nueva Valencia (300 to 350m.) The respective temperatures are 44°·5, 64° 0, and 96° 9, showing an increase proportional to the decrease in altitude, 1° for a difference of level of 6m. to 7m. After the springs of Urijino, Japan (100°), those of Trincheras are probably the hottest. The author gives an analysis of their water; also general descriptions of the others —*Reconnaissance* of the Napo (Equatorial America), by M. de Lesseps. This important affluent of the Amazon has been scientifically explored by M. Wiener, who in seven months has crossed South America in its greatest width, Quito to Para. The river is navigable a thousand miles from its entrance to the Amazon. He indicates a region larger than France well suited for colonisation.—On the treatment of vines with sulphide of carbon, by M. de Lafitte. —On the simultaneous reduction of a quadratic form and of a linear form, by M. Poincaré.—On Leverrier's tables of the motion of Saturn, by M. Gaillot.—On a property of the polynômes X_n of Legendre, by M. Laguerre —New tables for calculating heights by means of barometric observations, by M. Angot These tables give directly the height of each station above the level where the pressure is 760mm.; this is near the true altitude, an idea of which may thus be had without comparing results from two stations The exactness is at least as great as with the best formulæ proposed. The heights calculated differ always from the real height in a sense that can be known *à priori*.—Researches on sulphide of nitrogen, by M. Demarcay. —On phytolaccic acid, by M. Terreil. This new organic acid exists in the state of a salt of potash in the fruit of *Phytolacca Kæmpferi* (Its properties are described.)—Measurement of the toxical dose of carbonic oxide in different animals, by M. Gréhant. Great differences were observed: a mixture of $\frac{1}{800}$ strength was the poisonous dose for one dog, $\frac{1}{300}$ for another (the animals being made to breathe 200 litres). A rabbit required $\frac{1}{70}$ (breathing 50 litres). The smallest sufficing dose was that for a sparrow, $\frac{1}{4000}$.—On a new species of *Poroxylon*, by M. Renault This plant is named *P. Edwardsii*. The *Poroxyleæ* are found in the Upper Coal and Permian formations.—Transformation of a fructiferous ramification, resulting from fertilisation, into a prothalliform vegetation, by M. Sirodot. This was observed in *Batrachospermum vagum* (Roth).—Influence of light on the respiration of seeds during germination, by M. Pauchon These experiments were made on the castor-oil plant (as being oleaginous and albuminous) and on the haricot bean (feculent and without albumen). As in previous experiments, a good deal more O was observed in light than in darkness The castor-oil seeds exhale slightly more CO_2 in darkness than in light, but the opposite was the case with the seed of *Phaseolus* In darkness the ratio of CO_2 to O was for the haricot at least $\frac{1}{8}$ superior to that for the castor oil plant, but prolongation of the experiment tends to bring the relation equal to unity, whatever the original value. For a given quantity of oxygen absorbed the seed placed in darkness exhales more CO_2 than that kept in light. While in light there is always less CO_2 exhaled than O absorbed, the contrary occurs in darkness. These facts explain the transformation of legumin into asparagin. —Observations on the *rôle* attributed to maize, used as food, in the production of pellagra, by M. Fua. He considers M Faye's opinion, that pellagra may be caused by the large use of unfermented maize, to be in contradiction with facts. Maize is always eaten in the unfermented state. It forms the chief food of a large population in Central Africa, where pellagra does not occur, and similarly in Naples and in Hungary. He refers to certain alterations of maize (by fungi and oxidation).

Vienna

Imperial Academy of Sciences, December 2. Dr. L. A. Fitzinger in the chair.—On the theory of so-called electric expansion or electrostriction, Part ii., by Dr Boltzmann —Calculation of the absolute value and determination of the general equation of electrostriction, by the same.—On some properties of bromide of ammonium, by Dr Eder —Observations on contact-electricity (sealed packet), by Herr Schulze-Berge —Results of an investigation of the identity of the comets 1880 *e* and 1869 III, by Herr Zelber and Dr. Heppeiger —On graphic formula of hydrocarbons with condensed benzol-nuclei, by Herr Wegscheider.

CONTENTS

THURSDAY, DECEMBER 16, 1880

THE CHEMISTRY OF THE FUTURE

Ideal Chemistry. By Sir B. C. Brodie, Bart., D.C.L., F.R.S. A Reprint of a Lecture delivered before the Chemical Society on June 6, 1867. (London: Macmillan and Co., 1880.)

CHEMISTS who wish to study the "Calculus of Chemical Operations" will value this reprint of the lecture delivered by Sir Benjamin Brodie shortly after presenting his first memoir on the subject to the Royal Society, as it is in the main devoted to the description and explanation of the special symbols employed in the Calculus.

Even if this were the time and place, I should not venture to submit Sir Benjamin Brodie's views to that exhaustive analysis, which I believe has hitherto never been accorded to them, but which they must ere long receive at the hands of chemists. As yet only portions of the Calculus have been published, viz., Part I. "On the Construction of Chemical Symbols," and Part II. "On the Analysis of Chemical Events," although a valuable supplementary explanation of certain features was recently elicited by Naquet's criticisms. We have still to learn how the author proposed to treat of isomerism, by far the most intricate and difficult problem yet to be solved in chemistry, and let us hope that his departure from amongst us, which we now deeply lament, may not involve the suspension of judgment on this point he asked for but a short time ago being for ever.

I cannot refrain from devoting this notice to specially directing attention to what appears to me to be the topic of fundamental importance in the lecture, viz. the suggestion, made the author believes for the first time excepting in a few words at the conclusion of his first Memoir in the *Philosophical Transactions*, of the possible decomposition at the elevated temperature of the sun of certain chemical elements.

The fundamental hypothesis of the Calculus is to express the symbol of the unit of hydrogen by one letter, a. Hydrogen is to be regarded as constructed at once, by one operation. But while hydrogen is conceived of as the product of a single operation, the hypothesis indicates that oxygen, ξ^1, cannot be conceived of as made by less than two operations, while chlorine, $a\chi^2$, and nitrogen, $a\nu^3$, for example, are each to be conceived of as made by three operations, one operation in each case being that by which hydrogen is made. In short, the hypothesis involves the conclusion that there are several distinct classes—three at least—of "elements," of which hydrogen, oxygen and chlorine are the types, formed respectively by a single operation, by two similar operations, and by several operations not all similar. In other words, to quote the author, "we are led to a certain physical hypothesis as to the origin and causes of chemical phenomena." He then continues:—

"Now what I am going to suggest you must consider to be put before you with reservation, but we may conceive that in remote time, or in remote space, there did exist formerly, or do exist now, certain simpler forms of matter than we find on the surface of our globe—a, χ, ξ, ν, and so on—I say we may at least conceive of, or imagine, the existence in time and space of these simpler forms of being, of which we have some records remaining to us in such elements as hydrogen and mercury. We may consider that in remote ages the temperature of matter was much higher than it is now, and that these other things existed then in the state of perfect gases—separable existences—uncombined. This is the farthest barrier to which in the way of analysis theory can reach. Beyond all is conjecture. There may be something further, but if so, we have no suspicion of it from the facts of the science. We may then conceive that the temperature began to fall and these things to combine with one another and to enter into new forms of existence, appropriate to the circumstances in which they were placed. We may suppose that at this time water ($a\xi$), hydrochloric acid ($a\chi$), and many other bodies began to exist. We may further consider that as the temperature went on falling, certain forms of matter became more permanent and more stable, to the exclusion of other forms. We have evidence on the surface of our globe of the permanence of certain forms of matter to the exclusion of others. We may conceive of this process of the lowering of temperature going on so that these substances, $a\chi^2$ and $a\nu^3$, when once formed, could never be decomposed—in fact, that the resolution of these bodies into their component elements could never occur again. You would then have something of our present system of things."

We have here a most distinct prior statement by Sir Benjamin Brodie of views almost identical with those which have been so persistently urged for several years past by Mr. Lockyer, whose arguments, however, have hitherto met with but little sympathy from chemists, mainly perhaps on account of the unwonted character of the evidence. In his paper read before the Royal Society in December 1878, Mr. Lockyer adduced two lines of evidence in support of his hypothesis of elemental dissociation at high temperatures. The existence of lines common to several spectra—so-called basic lines—and the progressive alteration in the character of the spectra of the stars with temperature. Neither of these lines of argument has, I believe, yet been impugned, and the criticisms launched against the hypothesis have been on side issues of no real importance to the main question under discussion. More recently additional evidence in the same direction has been obtained by the comparison of the observations of Tacchini and others on solar storms. It appears that whereas at certain times lines which are admittedly all iron lines are visible, at other times certain of these lines are wanting from the spectrum, new lines appearing in their place: fluctuations of this kind taking place at frequent intervals, but evidently in accordance with some well-defined law. Facts such as these may after all meet with some other interpretation than that furnished by the "dissociation" hypothesis, although at present this affords by far the simplest explanation of them. A communication of Mr. Lockyer's, read at the last meeting but one of the Royal Society, however, adduces evidence which if confirmed must, it would seem, be regarded as final. It is well known that the velocity of uprush or downrush of vapours at the sun may be determined by observations of the amount of displacement from their normal position of the lines in the spectrum of the vapours, and obviously if all the lines in a given spectrum—that of iron, for instance—are lines due to one substance, it must be a matter of indifference by which of the lines the velocity is measured. Whereas, on the other hand, if this be not the case, and the simpler substances into which the body

is split up be of different degrees of volatility—of different molecular weight—we may expect that measurements of the displacement of different lines will not all furnish the same results. Mr. Lockyer states that in an observation of a sun-spot on August 31 of this year, when the iron line at λ 5207 6 was doubly contorted, indicating an ascending and descending velocity of about fifteen miles a second, the two adjacent iron lines at λ 5203 7 and 5201 6, visible in the same field of view, were perfectly steady Observations of this kind are necessarily very difficult, and the communication is made with all reserve; but it is to be hoped that observers elsewhere will co-operate in at once putting this observation to the test

It is difficult to exaggerate the importance of the question to the chemistry of the future, for should it once be proved that the dissociation of the so-called elements is taking place in the sun and still hotter stars, it will be within the power of the physicist with the aid of the telespectroscope to build up a theory of elemental evolution not inferior in interest to the doctrine of organic evolution For my part, I have no fear of the result, for apart from Sir Benjamin Brodie's hypothesis and apart from spectroscopic evidence, I believe that in the relations of the "elements" to each other when arranged more or less in accordance with the now well-known periodic law of Mendeljeff we have distinct proof of progressive development, but of this I hope to say more on another occasion.

Sir B Brodie points out in his lecture that if the symbol α'^2 were assigned to hydrogen, instead of the symbol α, a different symbolic system analogous in its form to the system in vogue amongst chemists would result In the second part of the Calculus he has fully explained his reasons for adopting the hypothesis α, notwithstanding that it leads to conclusions so entirely different from those ordinarily accepted, the chief reason being that this hypothesis satisfies the so-called law of even numbers—the law that the sum of all the units of affinity in a compound is an even number The recent remarkable discovery—probably one of the most important theoretically ever made by chemists—of the behaviour of the halogens at high temperatures would appear to furnish an opportunity of experimentally ascertaining whether Sir B Brodie's hypothesis α is admissible, for this hypothesis would not admit of a simple resolution of the diatomic molecules of chlorine, bromine and iodine into monatomic molecules which has been regarded as the more probable explanation of the results obtained by Victor Meyer and by Meier and Crafts. Two well-established exceptions to the law of even numbers exist, nitric oxide, NO, and nitric peroxide, NO_2, but as is well known, Sir B. Brodie has suggested that in these we may not be dealing with homogeneous gases, but that each is constituted of two gases which, taken together, are made up of oxygen and nitrogen, but which separately are not so made up: hypothesis α would lead to similar conclusions regarding the constitution of chlorine, bromine and iodine at high temperatures

At present all that is *established*, however, regarding the halogens is that iodine begins to undergo dissociation at a temperature between 600° and 700°, and that its vapour gradually diminishes in density until at a white heat it attains not far short of half the "normal" value. Whatever the nature of the dissociation products, the occurrence of dissociation must be regarded as *placed beyond doubt*, for Victor Meyer's results have been in the main confirmed not only by Meier and Crafts, but also by Deville and Troost, who had previously obtained normal results Bromine does not undergo dissociation so readily as iodine, the ratio of the observed to the theoretical "normal" density being, according to Meier and Crafts, ·8 for bromine when it is 66 for iodine. In a recent communication, Victor Meyer has stated that the results of his earlier experiments with chlorine would appear to have been vitiated by some as yet undiscovered source of error; this gas probably is not dissociated except at extremely high temperatures, and it is doubtful whether there is any difference in behaviour between free and nascent chlorine

HENRY E ARMSTRONG

HANDBOOK OF BOTANY

Handbuch der allgemeinen Botanik Von Prof Dr. N J C Muller Zweiter Theil Allgemeine Morphologie und Entwickelungslehre der Gewachse Pp 482, Figs 277 (Heidelberg, 1880 Carl Winter's Universitatsbuchhandlung)

THIS is the second instalment of a work by a single author which is to treat of all the different departments of botanical science The first volume, which is devoted to the consideration of the Physiology and General Anatomy of Plants, was reviewed in NATURE, vol xxi p 589 It is impossible to pass a more favourable verdict upon this volume than upon its predecessor It is characterised by the same failing, namely, a want of clearness and definiteness in the statement of important facts and fundamental principles. The first section of the book is devoted to a discussion of the theory of descent, the origin of species, and the occurrence of varieties and monstrosities, with the object, presumably, of making the reader acquainted with some, at least, of the influences which determine the forms of living organisms. The account of the morphology of plants begins at p 38, and after ten pages of general considerations the subject is actually grappled with. Prof Muller commences with the Thallophytes, though he does not call them so, for his first section on them is headed "Der Algenstamm" It is not easy to understand what he means by the suffix "stamm", does he mean to describe the thallus of the Alga as being a "stem," or does he use the word in the sense of "tribe"? Whichever be the true interpretation, it still remains unexplained why this word should appear as the heading of a section which treats not only of Algæ, but of Fungi as well. The prospectus of the work sets forth that the Classification of Plants is to form the subject of a subsequent volume, and there is therefore some hope that Prof. Muller will there give a classification of the Algæ which is more in accordance with facts and with reason than the one which he now follows. It is impossible to imagine on what grounds the Palmelleæ, the Protococcæ, and the Volvocineæ should be united together to form the Order Palmellaceæ, and yet this is done on p 51 of this work, although the author is evidently aware of the fact that in Volvox reproduction is effected by means of sexually produced oospores, as his account of that plant, a singularly inaccurate one be it said, on p. 62 testifies.

His account of the Lichens is not more trustworthy than that which he gives of Volvox He appears to be halting between two opinions with regard to the burning question of the nature of these organisms, for although he states on p. 69 that the germinating spore gives rise to both gonidia and hyphæ, thereby implying that those cells of the thallus which do not contain chlorophyll and those which do have a common origin, yet he admits (p. 74) that the gonidia may escape from the thallus and lead an independent existence, and further (p 84), that he has observed the formation of a lichen-thallus by the combination of algal and fungal forms which were originally distinct.

His treatment of the Cormophytes is also disappointing If the student, anxious to become acquainted with the most recent views as to such important points as the gymnosperms of the Conifers and the morphological significance of the embryo-sac and its contents in Flowering Plants, turns to the sections of this book which profess to treat of them, he will find only a few dogmatic statements with regard to the former point, and none at all with regard to the latter. Perhaps these points may have been thought too recondite for discussion in a work which professes to be a handbook for learners of the science, but many pages are devoted to the consideration of subjects, such as the more complicated forms of phyllotaxis, which have principally a mathematical interest Again, the morphology of the stem, of the leaf, and especially of the root, is dismissed far too summarily. It is to be hoped that these organs, as well as inflorescences, flowers, and fruits, will have justice done to them in the volume on the Classification of Flowering Plants. One further shortcoming must yet be mentioned, namely, the scantiness of the account given of the embryology of plants This is a subject which has been much studied in recent years, and, from the title of this book, it might naturally be expected that it would give a satisfactory account of the results which have been attained This is, unfortunately, by no means the case. Some of the facts are mentioned, it is true, but they are stated too briefly to be very intelligible, and no attempt seems to have been made to connect them together and to explain their significance.

It must be admitted that the book contains a considerable amount of information scattered through its pages, but the purely theoretical principles upon which this information has been arranged render it difficult of acquirement, and for this reason, if for no other, the book is not one which can be recommended for the use of students

OUR BOOK SHELF

The Gardens of the Sun, or, A Naturalist's Journal on the Mountains and in the Forests and Swamps of Borneo and the Sulu Archipelago. By F. W. Burbidge (London. John Murray, 1880)

THIS book is the itinerary of a competent and enthusiastic botanist, whose main object was "the collection and introduction of beautiful new plants to the Veitchian collection at Chelsea," in which he so far succeeded as to add about fifty ferns to the list of those already collected in Borneo, about twenty being also new to science, and to introduce alive the giant pitcher-plant of Kina Balu (*Nepenthes Rajah*, Hook. f.). But these alone by no means show the floral riches which have induced the author to use the by no means exaggerated term "Gardens of the Sun." Amongst epiphytal orchids which here growing in mid-air "screened from the sun by a leafy canopy, deluged with rains for half the year or more at least, and fanned by the cool sea-breezes or monsoons," is found the beautiful *Phalænopsis grandiflora*; nor in the mountain vegetation are like floral riches absent, at 5000 feet the curious pitcher-plant, *Nepenthes Lowi*, was found epiphytal on mossy trunks and branches, and higher still a "large-flowered rhododendron, bearing rich orange flowers two inches in diameter, and twenty flowers in a cluster" The forests and gardens of Borneo are equally rich in native and naturalised kinds of edible fruits, the mango, pine-apple, durian, rambutan, &c, being all alike plentiful and luxuriant, and, as Mr Burbidge remarks, in some favoured districts in Malaya the forests almost become orchards on a large scale, so plentifully are they stocked

Zoology was naturally less followed than botany, but still a collection of birds was made, notices of which, contributed by Mr. Sharpe to the Zoological Society, are appended to the volume. We however regret to find the word "alligator" still constantly occurring, whilst the word "boa" is equally misleading. Crocodile and python are words which do not seem to find a home in the East, nor moreover in many books of Eastern travel It is also quite erroneous to say that Borneo "is the only habitat of the wild elephant in the Malay Archipelago"; certainly so, at least, if we are not to exclude Sumatra from that region

Many ethnological facts are scattered about the volume; the account of the Jakuns of Johore is taken and fully acknowledged from Maclay's memoir on the subject in the "Journal of Eastern Asia", but the author contributes an interesting account of the method pursued by the Kadyans in playing the game of football No one but the student of games knows how difficult it is to find much or any information on this point in most books of travel

Tasmanian Friends and Foes Feathered, Furred, and Finned By Louisa Anne Meredith, Author of "My Home in Tasmania," &c With Coloured Plates from Drawings by the Author, and other Illustrations (London. Marcus Ward and Co, 1880)

IT will probably be granted that there is developed in most people a fondness for certain of what we are pleased to call the lower forms of animals Such are made pets of for various reasons the sweetness of their song, the brightness of their plumage, the splendour of their scales —these phenomena act as causes that attract the senses Their sometimes fond and gentle ways make of some, prime favourites, while a sense of their usefulness makes again of others indispensable companions to man.

Most of man's dumb companions have been taken from groups of animals with a more or less world-wide distribution, and it will no doubt be new to some of our readers to learn that in Australia—a country where the aborigines, for want of native pets, had to import at some time or another a dog—that there, such forms as brush kangaroos, wombats, bandicoots, and even great forest kangaroos—animals only known in these parts--can also become nice, quite gentle, mannerly things, doing a little damage now and then, it is true, by leaving long dirty tracks to bother the housemaid, like a boy home at Christmas time, or pulling up tulip-bulbs, or, worst of all, getting into the children's beds because they are comfortable. The beautifully got-up volume whose title heads this notice is written by a well-known and respected lady who has often before written pleasantly about her Tasmanian home and the bush friends she found or made there. In the present volume she writes an able defence of some of her dumb "marsupial" acquaintances, showing that

they too have intelligence, and that they exhibit at times a very respectable amount of common sense. The stories about them are strictly true, and from their very nature strictly new. But the volume tells also of many a two-footed friend, and the last few chapters almost exclusively treat of the fishes of the coast. There is much in this portion of the volume of interest to the scientific worker; there is much in every part of it to make it of value to those who care to learn something of the habits of Tasmanian beasts, birds, and fishes One feature of the volume must be specially noticed—the eight coloured drawings, excellently chromolithographed from the water-colour drawings of the author. From a personal knowledge of the splendid colouring often present in freshly-caught tropical fishes, these plates are, we should say, by no means too brilliant. Four are devoted to some of the strange, wondrously-coloured fishes, and four to flowers, fruits, and insects.

This volume would be an excellent and not over-expensive Christmas present, which may lie on any table however select, and be read by any person however critical.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*]

The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Mr. Spencer and Prof. Tait

Prof. Tait's explanation itself shows that the word commonly applied to products of imagination, was applicable to his statements, for the only justification he assigns is that he "assumed," that is to say, imagined, that his substitution of "definition" for "formula" must have been the ground of offence How inadequate a plea this is, will be seen on re-reading the questions I put, which were these:—

"He [Prof Tait] says that because he has used the word 'definition' instead of 'formula,' he has incurred my 'sore displeasure and grave censure.' In what place have I expressed or implied displeasure or censure in relation to this substitution of terms? Alleging that I have an obvious motive for calling it a 'formula,' he says I am 'indignant at its being called a *definition*.' I wish to see the words in which I have expressed my indignation, and shall be glad if Prof. Tait will quote them He says:—'It seems I should have called him the *discoverer of the formula!*' instead of 'the inventor of the definition.' Will he oblige me by pointing out where I have used either the one phrase or the other?"

Every reader would infer that, for these specific statements made by Prof. Tait, there are specific foundations, which could be named when asked for. He does not name them, for the sufficient reason that they do not exist Unable, as he says, to see in the passages I quoted from him, anything else to call for "censure" (a strange inability!), he "of course" assumed that this change of terms was the ground of censure And the assumption thus made, is the only warrant he assigns for these positive assertions.

This is not all, however. Prof. Tait says:—"I could not have ventured to suppose that Mr. Spencer '*did not even know that he was in the habit of saying formula rather than definition*' This naive confession cannot but be correct." Of Prof. Tait's motive for putting this statement of mine in italics and calling it *naive*, the reader may judge for himself. How entirely correct it is, and how well Prof. Tait might have "ventured to suppose" it, will quickly appear. For there is proof that I am *not* in the habit of always saying formula rather than definition, and Prof. Tait had the proof before him. In the note on page 565 of the Appendix forming the pamphlet in question—a page which Prof. Tait must have read, since it concerns Mr. Kirkman and himself—I have used the word "definition." So that not only had Prof. Tait no evidence on which to base his distinct statements, but there was under his eyes positive evidence which negatived them.

Very possibly it will be said that the question about my uses of these words is a trivial one But this is not the question. The question is whether it is allowable to make an opponent look absurd by ascribing to him, in a quite positive way, things which he has neither said nor implied; and that, too, when he has implied the contrary. HERBERT SPENCER

Criterion of Reality

Will you kindly allow a learner to ask for the criterion according to which Kinetic Energy and Work are real things, while Momentum and Force are unreal? Prof. Tait says $\frac{1}{2}mv^2$ and *wh* express real things, but *mv* and *wt* unrealities (NATURE, vol xxiii. p 82)

If *wt* be "as unreal as is the product of a quart into an acre," how is it that *wh* is real? The illustration of quart and acre is as applicable or inapplicable to the one as to the other. In both cases we take the product of two numbers, not two concrete magnitudes, which of course it would be absurd to speak of multiplying together. In one case the product is the number of units of Momentum, in the other case it is the number of units of Kinetic Energy. If it be said that a thing is real if its quantity cannot be altered, and *vice versâ*, why is mv^2 said to be real, and *mv* unreal? They vanish together When Prof Tait asserts "there is no such *thing* as Force," "it is merely a convenient expression for a certain *rate*" (NATURE, vol. xiv p 459), he seems, if I may venture to say so, to confound the measure of Force with Force itself, and to lay himself open to Mr Spencer's comment that "a relation changes the state of a body." Certainly *mv* is not a *thing*, but neither is mv^2 a thing: yet the latter is the measure of something which Prof. Tait asserts to be "as real as matter itself": why is not that of which the former is the measure equally real? E G.

Bardsea

[What Prof Tait asserts may be correct or not, but it is self-consistent. He asserts in his lecture on "Force" (NATURE, vol. xiv. p 462) that matter and energy must be looked on as real things, *because we cannot change the amount of either*. Such expressions as $\frac{1}{2}mv^2$, and *wh*, are to be considered as *wholes*, not as products of two or more factors This separation into factors (where one is *mv*, or *w*, for instance) he asserts to be a relic of the old erroneous belief in the trustworthiness of the impressions made on the "muscular" sense.—Ed.]

Landslips

In NATURE, vol. xxii. p. 560, I pointed out that landslips often occurred in the Salt Districts. I did not then expect that I should so soon be able to refer again to the subject, but on December 6, at an early hour in the morning, one of the largest subsidences and landslips ever known in Cheshire occurred. I pointed out that whenever fresh water reaches the rock salt it dissolves it. In certain districts in the immediate neighbourhood of Northwich the ground is completely honeycombed with rock-salt mines that had been worked out and abandoned. Into many of these fresh water had penetrated, and had become by solution strong brine This brine has of late been extensively pumped up, and many of these extensive cavities had become nearly empty. The thin crust of rock salt forming the roof of these old mines had become gradually thinner, owing to its solution by water, and on Monday morning the roof of one pit gave way, and let the superincumbent earth down into the mine, rifting and opening the ground to the surface. The surface rift passed across the bed of a large brook, and the water of the brook ran through the crevice into the mines below. In a short time the water made a more extensive cavity, and as the brook was cut in two about 200 yards above its entrance into a large lake that was drained by the Weaver River, the water in the lower portion of the brook and of the lake, as well as of the Weaver, commenced to return and run down the enlarged cavity. For four or five hours this return stream increased in velocity, pouring down the crater-like hole. Notwithstanding the water of the brook and the return water, as well as a large body of water from another small lake entering this cavity, the water standing in the funnel-shaped hole gradually lowered The velocity of both portions of the brook increased, and such was the force of the water that the bottom of the brook for 100 yards was scooped out from 2 feet in depth to 10 feet, and the banks were washed away,

making the brook from 30 to 40 feet wide instead of 20 as at first.

The quantity of water thus rushing down for twelve hours from the commencement would be fully 600,000 tons. The water in one direction over a surface of 160 acres was lowered one foot in the space of three hours Shortly after this water commenced to rush below it made its way through a weak portion of a barrier wall into a rock salt mine that was being worked. This mine, extending over fifteen acres, and having a worked-out depth of eighteen feet, was completely filled and all the tools, materials, waggons, tramways, &c., entirely lost. It will be quite impossible ever to pump out the water Besides this mine, all the old abandoned mines were filled, and the brine, which stood at 100 yards from the surface on the Sunday, stood at 24 yards on Monday night. The water being fresh, great damage was expected by the solution of the salt. This soon occurred, for an old mine that fell in forty two years ago, and the cavity of which had been filled with water, gave way, and suddenly the whole land over a circle of about 500 feet in diameter sank, and a large portion of water escaped into neighbouring pits. The ground cracked and rifted and subsided, and a length of road of 160 yards was destroyed, as also pipes conveying brine to the salt works A large reservoir holding brine was split across and all the brine let out, the rending of the earth passed through two kilns of bricks, dropping one-half of the kilns at least 2 feet On the Monday afternoon a tall chimney 90 feet in height became affected, and in a few hours fell with a great crash. The air that had filled the cavities below was forced out by the inrush of water, and caused all the pits and brooks near to bubble and boil violently, whilst in some of the rifts where water occurred miniature mud geysers were formed, throwing up mud 10 or 12 feet high. These appearances extended over a district between two brooks for the space of 2000 feet On Wednesday night a large hole 30 yards in diameter and 30 yards deep fell in, and more subsidences are daily expected, as the fresh water will eat away the pillars supporting the roofs of the abandoned mines.

The cavity formed on Monday is full of water, and the brook now runs through it Some idea may be formed of it when I mention that it is crater like, and of about 200 feet in diameter On sounding it on Wednesday I found a depth of 78 feet of water in the centre, and various depths from 70 to 60, 50, and so on to about 12 feet at the margin On Sunday, on the spot which is now 78 feet, there was a sandbank with its surface above the water.

Serious injury has been done to one set of salt works, and five sets are stopped for want of brine, the pipes being broken and the road destroyed.

As the salt trade increases these enormous sinkings keep increasing, and become more alarming in their character.

Brookfield House, Northwich THOS. WARD

The Geology of East-Central Africa and the Subterranean Forest in Bombay

IN Mr. J. Thomson's very interesting "Notes on the Geology of East-Central Africa" (NATURE, vol xxiii. p 104) he remarks that doubtless the immense development of volcanic rocks described by myself (and I may add by several previous explorers) in Abyssinia is of the same age as the volcanic rocks at the Cape of Good Hope, assigned to the Trias.

Mr. Thomson has, I think, overlooked the circumstance that whatever may be the age of the Cape volcanic rocks, the traps of Abyssinia cannot be older than Jurassic As I have shown (*Quart. Jour. Geol. Soc.*, 1869, pp. 403, &c., and "Geology and Zoology of Abyssinia," pp 184, &c.), there are in the Abyssinian highlands two groups of bedded dolerites and trachytes, the upper of which rests unconformably on the lower, while the latter overlies limestone with Jurassic (Middle Jurassic) fossils

I trust that Mr. Thomson will pardon my suggesting the possibility of the Tanganyika sandstones being river valley deposits, like the Gondwana series of India, rather than lacustrine. I may be mistaken, but the description appears to me to indicate beds coarser than those usually deposited in an extensive lake basin.

In the same number of NATURE, p. 105, is a brief notice of a "Subterranean Forest in India." As I understand the account given, the forest should perhaps rather be termed submarine than subterranean. My object in calling attention to this notice however is to point out that a previous description of the same formation was published in the *Records* of the Geological Survey of India for 1878, vol xi p 302 This account is by Mr. G E. Ormiston, Resident Engineer, and agrees in all essential particulars with the note in NATURE I appended a few remarks on the geological bearing of the discovery. The "forest" has clearly been depressed, whilst neighbouring tracts in Bombay island appear to have been elevated in comparatively recent times.

W. T BLANFORD

Dr. Siemens's Gas-Grate

HAVING endeavoured for some years past to heat my study by gas appliances, and having utterly failed in obtaining a comfortable temperature of 60°, as a last effort to accomplish my object I had fitted into an ordinary grate Dr. Siemens's arrangement of copper and iron, the construction of which was communicated to the public in the pages of NATURE, vol. xxiii p. 25 Before giving the results of the trial of Dr. Siemens's gas-grate I may mention in what way my former gas-stoves failed My first gas-fire consisted of gas and asbestos, but this gave out fumes which were quite intolerable, my second trial was with a gas-stove reflecting heat from a copper lining, this not only failed to warm the room, but was a cheerless and grim apology for a fire, and to obtain even a moderate degree of temperature a constant and expensive consumption of gas was necessary With Dr. Siemens's gas-grate all that is required to produce a good cheerful fire radiating heat to all parts of the room, and maintaining a temperature from 60° to 62°, is to turn on the gas full for about twenty minutes, and as soon as the lower stratum of coke becomes incandescent, the gas may be quite turned off, the fuel, whether coke or anthracite, continuing to burn for five or six hours without any further expenditure of either gas or fuel

If the fire is required for a longer time, or if at any time a more rapid combustion is wanted, it is only necessary to turn on the gas again for a few minutes and add more fuel. This is my experience of Dr. Siemens's gas-grate, and I consider it a great boon to householders who desire well-warmed rooms combined with economy After the lucid description of the gas-grate given by Dr Siemens in NATURE, it would be presumption in me to discuss the scientific explanation of its action, I shall only, in conclusion, venture to claim for it the following advantages which I believe it to possess over every other kind of gas stove yet invented —

1 It gives a clear, smokeless, cheerful fire

2 It is most economical, and very soon pays the cost of the construction.

3 Being absolutely smokeless, contributes nothing to that constituent of our London fogs which renders them injurious in so many ways.

This last advantage, if multiplied by every householder at an outlay of 25*s*., adopting a cheaper modification than the copper and iron gas grate, we should before very long observe a marked change for the better in our London atmosphere, and the darkness, dirt, and destruction of property with which we Londoners are annually afflicted, would be things of the past

December 13 R DOUGLAS HALE

Geological Climates

I HAVE just read Mr. A R Wallace's letter in NATURE, vol. xxiii p. 124, but as I have not yet seen his book, "Island Life," although my bookseller had promised it, I shall defer my reply in NATURE until I shall have made myself master of his ideas.

For the present I shall only say —1. That Mr Wallace's proposal would benefit the Polar regions but not Bournemouth. 2 Mr. Wallace omits all mention of the *return cold currents* which the admission of two new Gulf Streams into the Arctic regions would produce. These currents would seriously lower the temperature of China and Japan, and also of the Ural Mountains and east of Europe.

SAMUEL HAUGHTON

Trinity College, Dublin, December 10

SOME weeks since the Rev. Prof. Haughton took exception to a brief letter of mine, in which I suggested that as a bamboo flourishes in Cooper's Hill College garden, in a northern aspect winter after winter, it could be used effectually in an argument relating to geological climates The bamboo being found in torrid India now, that at Cooper's Hill, if found in a future period, would, according to some geologists, indicate that the valley of the Thames was tropical formerly. My letter was

written because the Rev. Professor had written a very long one, in which he applied this kind of bad reasoning in relation to a bit of a leafy part of a tree found at Bournemouth in an Eocene deposit The leaves of his bit resemble those of *Araucaria Cunninghami* squashed, nevertheless a thermometric virtue is given to the fossil because this Araucaria is native in districts in Eastern Australia

Self-satisfied with his recognition of the similarity of the leaves, the Rev Professor coolly assumes that he has made out his species, and therefore demands the name of mine, giving me a scolding before I could possibly let him have it.

It is curious that the Rev Professor should not have seen the point of my letter, and the only explanation is that he was so taken up with the incomparable value of his delicate "self-registering plant thermometer." I did not believe in his discovery, and my bamboo—never mind whence it came—was quite as good in the method of argument as his so called Araucaria No botanist would feel satisfied with the coneless evidence of the Rev Professor, and his genus is in doubt as well as his species. With regard to this, Lindley stated years since that *Araucaria Cunninghami* is a "supposed species" in relation to the Norfolk Island *C excelsa* So the "self-registering thermometer" has neither bulb nor stem, and the spirit or the mercury represents the Rev. Professor's genius He bids me plant the bamboo in the sunny south west Not so, it is the damp soil and the shade which have permitted the stems to grow up to 10 feet 6 inches. He tells me that the bamboo grows in China that fact I had heard of before, and it has been strikingly impressed on many generations of Celestials Last week, but too late for my purpose of immediate publication in NATURE, I learned that the bamboo is of the sub-genus *Arundinacea*, and the species is *falcata* Its natural habitat is in the temperate Himalayas, where frosts, fogs, and north-east winds, such as plague the Thames Valley, are unknown

Finally I believe that the so-called *A Cunninghami* has grown of late years in the south of England

December 9 P. MARTIN DUNCAN

Hailstorm in Dorsetshire

AT about 1 30 on the 25th of last November, with a strong wind from the south-west, this place was visited by a hailstorm which lasted about five minutes, accompanied by rain and violent gusts of wind, and by a single vivid flash of lightning which was followed with scarcely more than an appreciable interval by the thunder.

The character of the hailstones which fell on the occasion, and which I examined before they could have undergone any important change induced by the higher temperature of the surrounding air, may be worth noting, for though they were not of very unusual size, and in most respects scarcely departed from what may be regarded as the typical condition of hailstones, they exhibited some features not generally met with in so well-marked a form.

In their simplest condition their shape was that of a sphere, and in every such case they consisted of a spherical nucleus of

opaque white ice enveloped by a concentric shell of ice perfectly transparent and homogeneous, showing none of the radial striæ often met with in hailstones (Fig. 1) The largest measured about half an inch in diameter, the nucleus having a diameter of about a quarter of an inch. The appearance of the opaque white nucleus surrounded by its thick crystal-clear envelope was very striking and beautiful.

In many cases two such hailstones were united firmly to one another, doubtless by a process of regelation after contact. In some of these the transparent envelope was continuous around each of the nuclei in the plane of contact (Fig 2) In others it was here deficient, and the two nuclei were then in immediate contact with one another (Fig. 3). The difference thus presented is not without significance as affording evidence that there are two distinct conditions under which the union of hailstones by regelation may occur; for it is probable that in the former case the contact and regelation had taken place directly between the nuclei while as yet free from the investing shell of clear ice which had afterwards formed around the twin nuclei, while in the latter case the envelope had already existed before the contact and regelation of the hailstones.

Another frequent occurrence was the presence of one or two little piriform offsets, which projected from the surface of the hailstone, and were, like the envelope itself, formed of clear homogeneous ice (Fig. 4) In a paper published in the *Proc.* Asiatic Society for June, 1880, to which my attention has been called by Mr. Scott of the Meteorological Office, very similar club-shaped projections of transparent ice are described by Mr. Blanford in large hailstones figured by Col. Godwin-Austen as having fallen at Calcutta in March, 1877

It is possible that in these cases the projections had originally the form of crystals, and that their faces and angles had been rounded off in passing through a warmer region of the atmosphere, such radiating crystals of ice not being unknown In a memoir by Abich ("Ueber Kugel Hagel im Unterem Kaukasus," Vienna, 1879), for a knowledge of which I am also indebted to Mr Scott, an account is given of certain very large hailstones which fell at Tiflis in Georgia, and had large ice crystals radiating from the surface. GEO. J ALLMAN

Ardmore, Parkstone, Dorset, December 11

Sargassum

I FIND in NATURE, vol xxiii p. 70, a short report on my paper, "Revision von Sargassum," with several objections, which I believe to be erroneous It is said that the fragments occurring sometimes on the open sea, the so called *Sargassum bacciferum*, should have a bright yellow colour Not long ago I received fresh samples thereof from the Sargasso Sea, which are not yellow at all, these fragments are never bright yellow, but of the same brown, varying to yellowish colour as decaying *Fucus vesiculosus* I observed the latter, for instance, in this condition in several fjords of Norway, where I found broken Fucus in greater quantities than ever I did Sargassum in the open sea between England and the West Indies

Macrocystis pyrifera shows always stem and leaves entangled in a ball, if broken and swimming in the open sea (*vide* p. 235 of my treatise), and the Sargasso fragments of the open sea are also often entangled in compact balls, as Sir Wyville Thomson states ("The Atlantic," i. 194), and as it may be seen on my phototypic table, Fig. 1

If the floating Sargassum should have no reproductive organs, this would be no difficulty, but rather a confirmation of my views on the fragmentary nature of swimming Sargassum, for a particular pelagic species could not be without reproductive organs Besides there have been found "with certainty" sometimes samples in the open sea with reproductive organs, and I gave an explanation of their seldom occurrence by want or breaking off of the air vesicles The writer on my paper is mistaken in comparing Macrocystis and Fucus with Sargassum, for the air-vesicles and reproductive organs of Sargassum are separate from the leaves and isolated on thin stalks, which break off easily, while those of Fucus and Macrocystis are never separate, but in the middle of the leaf or on the base, or on the broad end of the leaf or thallus. Therefore swimming Sargassum is found often without reproductive organs, and its air-vesicles are often broken off, whilst on Macrocystis and Fucus such a separation is not possible. Having refuted those objections, and having also brought in my paper many more arguments against the existence and vegetation of *Sargassum bacciferum* than there are mentioned in the short report, I hope that my results on Sargassum will now generally be accepted

Leipzig-Eutritzsch, December 4 OTTO KUNTZE

Note on an Acoustical Constant

THE number of vibrations executed in a second by a stretched string is generally represented in the text books by a formula expressing the method of its variation with the determining circumstances, such as—

$$n \propto \frac{1}{dl}\sqrt{\frac{T}{s}},$$

where d is the diameter, l the length, s the specific gravity of the string, and T the tension or stretching force, but the absolute number of vibrations is not generally given by the formula.

Now if we write instead of the above—

$$n = \frac{k}{d\,l}\sqrt{\frac{T}{s}},$$

where k is some constant, it is evident that k will not depend on the nature of the string but solely on the system of units employed to express d, l, and T.

If C.G S. units be employed, we have, as stated in Prof. Everett's translation of Deschanel—

$$n = \frac{1}{2\,l}\sqrt{\frac{T}{m}},^{1}$$

where m is the mass of unit length; and as we may write instead of m, $\pi r^2 s$, r being the radius of the wire, we shall have—

$$n = \frac{1}{\sqrt{\pi}} \cdot \frac{1}{2\,r\,l} \cdot \sqrt{\frac{T}{s}}, \text{ or } \frac{1}{\sqrt{\pi}} \cdot \frac{1}{d\,l} \cdot \sqrt{\frac{T}{s}},$$

so that here $k = \frac{1}{\sqrt{\pi}} = \cdot5642$ approximately.

With any other system of units we may of course determine k from the value just given, by multiplying or dividing by the ratios of the new to the C G.S. units, for example, if d be expressed in millimetres, l in metres, and T in kilogrammes, our new constant would be—

$$k = \frac{1}{\sqrt{\pi}} \cdot \frac{10}{1} \cdot \frac{1}{100} \sqrt{981000}$$

$$= \frac{99\cdot04}{\sqrt{\pi}} = 55\cdot87.$$

But we may also determine k directly for any system of units in the following manner:—If, in the formula—

$$n = \frac{k}{d\,l}\sqrt{\frac{T}{s}},$$

we make d, l, T, s, each unity, we shall have—

$$n = k$$

Imagine then a wire of water, 1 mm. diam., 1 metre long, stretched by a weight of 1 kilo., its weight would be 7854 grm., and H, the "tension length," or length which would be equal in weight to the stretching weight, would be $\frac{1000}{\cdot7854}$ $= 1273\cdot2$ metres. The velocity v of transmission of a pulse along the wire would be $\sqrt{g\,H} = \sqrt{9\cdot81 \times 1273\cdot2} = 111\cdot76$ metres per second, and the number of vibrations per second—

$$n = \frac{v}{2\,l} = \frac{111\cdot76}{2} = 55\cdot88 = k,$$

the same figure as that obtained above.

If the units in which d, l, and T are expressed are respectively the tenth of an inch, the foot, and the pound, k becomes 48·66

In the later editions of Ganot's "Physics" we find the formula—

$$n = 9\cdot8257\sqrt{\frac{c}{l}}$$

given, where c is the "tension length," and l the length of the string, both expressed in inches. This formula would of course be of more easy application than those given above when we know the weight per foot of the string, but does not directly show the relation of n to the diameter and specific gravity

W. J GREY
J T. DUNN

Newcastle-on-Tyne

The U.S. Weather Charts

I SHOULD be much obliged if you would inform me whether the United States Monthly Charts of Meteorological Data, in continuation of the series published in NATURE, can be procured in London, and if so where.

H. M

6, Charles Street, Grosvenor Square, December 7

Climate of Vancouver Island

MR. ALFRED R. WALLACE asserts in his letter published in NATURE, vol. xxiii. p. 124, that the climate of Vancouver Island is not so mild as that of London

For three years I commanded a gunboat on those shores, speaking from recollection, and not from recorded observations, and with great deference to so distinguished a naturalist as Mr. Wallace, I should have said that the climate of Vancouver Island was a good deal milder than that of London

EDMUND H. VERNEY

Travellers' Club, Pall Mall, S W., December 11

Meteors

ON the evening of November 20 at about 8 p m my attention was attracted by a number of meteors appearing as often as once per minute in different quarters of the heavens, but pursuing courses apparently radiating from a point near the constellation Andromeda

M A. VEEDER

Lyons, New York, November 22

THE PROBABILITY OF PHYLLOXERA CROSSING THE TROPICS

MUCH alarm has been felt by the wine-growers of South Africa at the possibility of the phylloxera being introduced into the Cape vineyards Very stringent regulations have been framed in consequence, prohibiting the importation of living plants or vegetables in any form, and so rigidly have these regulations been carried out that it is stated that, in accordance with them, a cargo of potatoes from New Zealand was destroyed on its reaching Capetown

It is generally conceded by the experts who have been consulted that the importation of vines, on the tissues of which the phylloxera would be able to live in transit, must be prohibited The phylloxera can however, it is admitted, feed on no other plant but the vine, and the important question for the South African Government to decide is whether it is really needful to exclude other plants or vegetables besides the vine In order to obtain the best opinion upon this point, Dr Maxime Cornu was consulted He accordingly drew up several reports, in which he expresses the opinion that, though extremely unlikely, it is still theoretically possible that the phylloxera should be conveyed from Europe to South Africa by means of other vegetable products than the vine, and he therefore supports the prohibitive action taken by the Cape Government

The inconvenience to the community which such a policy involves is necessarily considerable The grounds of Dr Maxime Cornu's decision have therefore been carefully considered by an entomologist who has studied the subject and who has drawn up the following notes The question is of great importance to all wine-growing countries in the southern hemisphere, and as these doubtless contain many readers of NATURE, I think the publication of these notes in its columns will give them the best opportunity of being fairly considered

W. T T. D.

Notes on Dr Cornu's Reports on the Phylloxera, and on the Protective Measures against its Introduction

Among the "truths" laid down in the first report, No. I is, "The *Phylloxera vastatrix* lives only upon the vine" This is emphasised in the third report ("Memorandum on Laws of Protection, &c"), Paragraph No IV, stating, "they (the insects) can, moreover, subsist only upon the vine"

Notwithstanding these unreserved statements of this fundamental fact in the life history of phylloxera, the same "Memorandum on Laws of Protection, &c," proceeds (in its "General Conclusion") to recommend, "if such a course were possible," the imitation of "the example set by Algeria, and to forbid the introduction of all vegetable products whatever, with the exception of those which are absolutely required for consumption"

It may well be asked on what ground such a recommendation is based After stating (Third Report, Paragraph IV) that the phylloxera cannot live when dissociated from the vine for more than four or five days, and requires protection from dessication in any case, Dr

Cornu proceeds (Paragraph V) to sketch "the most favourable conditions for the introduction of the insect" as follows:—"A phylloxera is removed in the soil, say a pregnant mother, which survives for a period of five days; it lays an egg before dying, the egg takes fifteen days to hatch (at the mean temperature of 59 deg Fahr), and the young insect which is produced five days to die. This makes in all twenty-five days" That is to say, that the maternal phylloxera, when in *articulo mortis* at the end of her five days' dessication and starvation, is to lay an egg; that this egg, produced under such extraordinary conditions, is to hatch in due course, and, after undergoing total starvation from its birth, is to live out the normal term of five days allotted to the mother (presumably well fed until she started on the dolorous voyage), and after all this is to land at the Cape and propagate its species in the nearest vineyard at hand! If these are "the most favourable conditions" under which the phylloxera would be introduced, we may surely say with Dr. Cornu in another part of the same report (Paragraph VII. *a*) that "it would require a concatenation of circumstances which it is difficult to imagine to bring about the misfortune of the insect's introduction." It is as well also to note that the writer expressly states (Paragraph V.) that the egg's hatching is accelerated when the temperature exceeds 59 deg Fahr., so that in the supposed case, if the starveling progeny ever did see the light on the voyage, it would probably emerge in a tropical temperature long before the normal fifteen days allowed, and so resign its life of total abstinence before reaching the promised land of plenty at the Cape.

Let us now turn to the "winter egg," which, as Dr Cornu states (Paragraph VI.), "is particularly to be dreaded" This is the rarest condition of the insect, each female of the generation which includes both sexes laying only one egg (Paragraph VI)

"It is to this egg alone that the introduction of the phylloxera in packing-cases, straw, &c, could be attributed, this would however require confirmation; in fact I am not aware of any well-authenticated instance of the introduction of the phylloxera resulting from the transmission of the winter egg" (Paragraph VII).

This admission on the writer's part seems to reduce any apprehension about the winter egg to infinitesimal proportions, especially when it is noted that the "winter egg," as its title implies, is a state limited to cold weather, and "commences to develop at the return of the fine weather" (Paragraph VI.) If a specimen of this rare *œuf d'hiver* did by any chance (in the absence of the vine-stems or branches upon which it is laid) start on a voyage for South Africa, we may be very sure that in its passage through the whole extent of both tropics it would very speedily cease to merit its title, and become a miserable *phylloxèra d'été*, only to share the fate of its luckless relative, produced from the last dying egg of the *mère pondeuse*. It does not mend matters to find Dr. Cornu stating in italics (Paragraph VII.), "Such introduction is nevertheless possible from a scientific point of view" Impossibility can with accuracy be predicated of but very few propositions, as a rule it is safer to say of most matters apparently incredible that it is next to impossible, and this may very certainly be said in the present case, and when all known facts and conditions place every probability against a bare possibility, wise men will know how to act.

As long as vines and all parts of vines from abroad are kept out of the Cape, the requirements of the wine industry are fully met This prohibition was put in force by the late Government, by Proclamation No 88, of November 30, 1876, and has been in force ever since that date. As late as the 4th December last, attention was specially directed to this Proclamation, with the intimation that its provisions would be strictly enforced (in Government Notice, No. 1288, of 1879) The present superfluous and vexatious restrictions were added by Proclamation No 14, of January, 1880, and all the facts adduced by Dr. Cornu point to their futility.

SONGS OF THE SCIENCES—I. ZOOLOGY

WE must regard it as a noteworthy sign that science has begun to percolate so through society generally that it has reached the pages of *Punch* Almost every week we find a bit of more or less telling waggery, and last week the first of a series of "Songs of the Sciences" appeared, which we reproduce:—

Oh! merry is the Madrepore that sits beside the sea,
The cheery little Coralline hath many charms for me;
I love the fine Echinoderms of azure, green, and grey,
That handled roughly fling their arms impulsively away:
Then bring me here the microscope and let me see the cells,
Wherein the little Zoophite like garden floweret dwells.

We'll take the fair Anemone from off its rocky seat,
Since Rondeletius has said when fried 'tis good to eat;
Dyspeptics from Sea-Cucumbers a lesson well may win,
They blithely take their organs out and then put fresh ones in.
The Rotifer in whirling round may surely bear the bell,
With Oceanic Hydrozoids that Huxley knows so well.

You've heard of the Octopus, 'tis a pleasant thing to know,
He has a ganglion makes him blush not red, but white as snow:
And why the strange Cercaria, to go a long way back,
Wears ever, as some ladies do, a fashionable "sac";
And how the Prawn has parasites that on his head make holes,
Ask Dr. Cobbold and he'll say they're just like tiny soles

Then study well zoology, and add unto your store,
The tales of Biogenesis and Protoplasmic lore.
As Paley neatly has observed, when into life they burst,
The frog and the philosopher are just the same at first.
But what's the origin of life remains a puzzle still,
Let Tyndall, Haeckel, Bastian go wrangle as they will.

THE AUGUST AURORAS

AS I had the pleasure of witnessing to great advantage at Christiania the superb aurora of August 12 last, as well as that of the 13th, it is possible that some account of these displays as seen in Norway may be useful for comparison with accounts of their appearance in England.

My attention was first drawn to the aurora on going into the open air at 11 p m At 10.30 p.m a friend had remarked that the night seemed unusually dark, and that the stars were shining brightly. When first seen by me the aurora consisted of a wide arch of diffused light, the centre of which was about 30° in height. A few broad streamers were then beginning to appear. I walked as quickly as possible to a hill whence a good view could be obtained, but I had hardly got there before the aurora had already reached, about 11.10 p m, its maximum splendour. Broad streamers had by this time covered almost the whole of the northern half of the heavens, converging to a point considerably south of the zenith, forming a grand corona The arch was still highly luminous, and from its upper margin coruscations or waves of white light shot up every two or three seconds towards the zenith. At this time also there suddenly appeared to the east of magnetic north a splendid sheaf of rays proceeding from the horizon altogether beyond the auroral arch, and apparently in complete independence of it. These rays, through bright, attained an elevation of only some 35°, and belonged apparently to a distinct auroral discharge. At 11.15 the arch had already begun to fade, but a mass of rays shone out brightly near its eastern termination. Throughout the display I was struck by the tendency to the formation of compact bodies of streamers which seemed to flank each end of the arch. As the arch faded the pulsations of

light increased in frequency and brilliancy, and at 11.25 they might be described as broad flashes overspreading a large part of the northern half of the sky, always travelling upwards, and sometimes passing the zenith. The main body of streamers had by this time mostly faded, after going through an extraordinary series of changes which I found it quite impossible to record Every minute or two new rays would strike up to the zenith, or sometimes beyond, and every now and then a portion of an older ray would suddenly shine out with a kind of phosphoric light.

The display now rapidly faded, and though at 11 35 and again about 11.45 there were minor reappearances of rays, the aurora seemed to be near its end, and I returned home.

The brightness of the phenomenon was somewhat delusive, for when a superb corona of rays covered the northern sky, I could only just read my watch by its light, and could not read what I endeavoured to write down on paper The light was either white or of a greenish yellow tinge. There was no trace of the redness or other colours seen on other occasions.

By very good fortune I was able to watch the aurora of the next night (August 13) under the most favourable possible circumstances, namely, while steaming down the Christiania Fyord, in the steamship *Angelo*, during a beautiful calm evening. The aurora began at 10 20 p.m with a very faint uniform arch, or rather line of white light, appearing 8° or 10° above the horizon, with difficulty distinguished from the twilight. This soon faded away entirely, but at 10 35 reappeared as a very distinct luminous arch, separated by a dark space from the twilight. Some slight signs of rays now also appeared

At 10.45 the arch seemed to be rising somewhat, without ever attaining a height of more than about 15°. The lower edge became indented by ray-like notches There was a tendency to the formation of streamers at the flanks. At 10 50 a fine single ray shot up from the horizon right through the arch, at 10° to west of true north. Streamers also began to appear above the arch, and especially at its eastern end, but the streamers were in no way comparable to those of the previous night The arch now began to lose its previous regular form, and to go through a remarkable series of gradual changes and contortions, which it is impossible to describe By degrees the eastern end became incurved in the manner of a folded curtain (like the pictures of auroras in the Polar regions which we see in books), and a few fragments of rays tended to form an inferior arch.

For more than an hour the light of this aurora was steady; but about 11 30 p m pulsations first began to appear faintly, soon increasing in frequency and width. As the pulsations grew the arch almost insensibly disappeared, but patches of light and fragments of rays occupied the sky above where the arch had been, and were every instant lighted up, as it were, by the passing coruscations These flashes of light became more and more frequent, following each other every second, or even several times in a second, so as to produce at last a kind of rustling or dancing appearance. They were most intense upon the rays and patches, but were not confined to them. At 12.30 the display was failing, the waves being less frequent. At 1 a.m. there remained only a few irregular patches of faint, steady light, with occasional flashing waves. The light was again white, or greenish yellow. On neither occasion did the aurora seem to have the slightest relation to the ordinary vaporous clouds of the atmosphere, nor did the dark space beneath the arch seem to be more than might be explained as the effect of contrast.

Mr. Thomas Bennett, who is well known to all Norwegian travellers, and has resided many years in Christiania, informed me that the aurora of the 12th was probably the finest he had ever seen among the many grand displays which occur in Norway. Though I have witnessed several fine auroras, including some of those seen in the United States in August and September, 1859, and two fine displays of the Aurora Australis (September 14 and 16, 1854), I cannot call to mind that I ever saw coruscations or waves of electric light at all approaching those seen at Christiania on this occasion. The books say comparatively little about these coruscations, nor do the letters in NATURE, vol. xxii. p 361, mention them as seen in England Yet they probably represent the most important part of the phenomenon, the active discharge of electric energy

I neither saw nor heard anything in Norway of an aurora on the night of August 11. About the dates I give there can be no possible mistake, because the steamboat from Christiania to Hull departed as usual on Friday evening (August 13) The times mentioned are the local times by the public clock at the Christiania University Buildings. W. STANLEY JEVONS

P.S.—The above account was mostly written a few days after my return to London, according to notes taken at the time. I print it now for what it may be worth. After thinking the matter over for three months, and comparing the auroral coruscations above described with the exquisite discoveries of Mr. Crookes, taking into account also some remarks in the article on auroras in the new edition of the "Encyclopædia Britannica," I venture to make the suggestion that these coruscations arise from highly tenuous matter (in what Mr. Crookes calls the *radiant state*) projected through the higher parts of the atmosphere. It is not possible by words to give an impression of such a phenomenon in the least degree approaching to that naturally acquired by watching it under favourable circumstances for several hours. My belief is, that during the auroras described, *puffs*, as it were, of radiant matter were discharged at a great elevation above the earth's surface, and the luminosity of these puffs perhaps arises from conflicts between the projected molecules and those already spread about the almost vacuous space. The arch and most of the streamers probably belong to a lower, though still a very high part of the earth's atmosphere, but certain of the streamers, as well as patches of luminous matter seen on the night of the 13th, certainly exist in the lofty regions through which the radiant matter is projected The explanation of the streamers must probably be approached through that of the coruscations, but they are effects of a very different kind W. S. J

November 22

THE INFLUENCE OF A TUNING-FORK ON THE GARDEN SPIDER

HAVING made some observations on the garden spider which are I believe new, I send a short account of them in the hope that they may be of interest to the readers of NATURE

Last autumn, while watching some spiders spinning their beautiful geometrical webs, it occurred to me to try what effect a tuning-fork would have upon them. On sounding an A fork and lightly touching with it any leaf or other support of the web or any portion of the web itself, I found that the spider, if at the centre of the web, rapidly slews round so as to face the direction of the fork, feeling with its fore feet along which radial thread the vibration travels. Having become satisfied on this point, it next darts along that thread till it reaches either the fork itself or a junction of two or more threads, the right one of which it instantly determines as before. If the fork is not removed when the spider has arrived it seems to have the same charm as any fly. for the spider seizes it, embraces it, and runs about on the legs of the fork as often as it is made to sound, never seeming to learn

by experience that other things may buzz besides its natural food.

If the spider is not at the centre of the web at the time that the fork is applied, it cannot tell which way to go until it has been to the centre to ascertain which radial thread is vibrating, unless of course it should happen to be on that particular thread or on a stretched supporting thread in contact with the fork

If when a spider has been enticed to the edge of the web the fork is withdrawn and then gradually brought near, the spider is aware of its presence and of its direction, and reaches out as far as possible in the direction of the fork, but if a sounding fork is gradually brought near a spider that has not been disturbed, but which is waiting as usual in the middle of the web, then instead of reaching out towards the fork the spider instantly drops—at the end of a thread of course If under these conditions the fork is made to touch any part of the web, the spider is aware of the fact and climbs the thread and reaches the fork with marvellous rapidity. The spider never leaves the centre of the web without a thread along which to travel back If after enticing a spider out we cut this thread with a pair of scissors, the spider seems to be unable to get back without doing considerable damage to the web, generally gumming together the sticky parallel threads in groups of three and four.

By means of a tuning-fork a spider may be made to eat what it would otherwise avoid I took a fly that had been drowned in paraffin and put it into a spider's web and then attracted the spider by touching the fly with a fork. When the spider had come to the conclusion that it was not suitable food and was leaving it, I touched the fly again This had the same effect as before, and as often as the spider began to leave the fly I again touched it, and by this means compelled the spider to eat a large portion of the fly.

The few house-spiders that I have found do not seem to appreciate the tuning-fork, but retreat into their hiding-places as when frightened, yet the supposed fondness of spiders for music must surely have some connection with these observations, and when they come out to listen is it not that they cannot tell which way to proceed?

The few observations that I have made are necessarily imperfect, but I send them, as they afford a method which might lead a naturalist to notice habits otherwise difficult to observe, and so to arrive at conclusions which I in my ignorance of natural history must leave to others.

C. V. BOYS

Physical Laboratory, South Kensington

THE MINERALOGICAL SOCIETY OF GREAT BRITAIN AND IRELAND

THERE was a time, now almost beyond the memory even of the oldest inhabitant, when the stillness of our learned halls was unbroken by the wrangle of contending geologists, when the science of geology could not be said yet to exist, when those who occupied themselves with stones found a congenial atmosphere of solemnity in the quiet domain of crystallography, whence with the boldness of adventurers they made little excursions into the more open and dangerous waters of chemistry. Days of slumberous peace as they now seem to one who turns over the ponderous dusty pages in which their records are duly chronicled! To the mineralogist of those days the interest and importance of rock-masses was measured by their richness or poorness in mineral specimens. Surrounded by his cases of minerals—the reward of years of patient toil and judicious expenditure, with what tender interest would he survey his treasures! We knew him in old times, yea and loved him. Enthusiastically would he describe how he had contrived to secure that priceless unique crystal; how day after day he had searched the rocks in vain, till at last one lucky stroke of the hammer laid open that magnificent druse; how he had bought that matchless group from a sailor who used it to keep down the lid of his tobacco box. Kindly too he was, and all the more if you took interest in his favourite pursuit. Ask him to tell you the difference between two resembling minerals, and he would launch out with evident relish into his "external characters." Lovingly would he handle the specimens, as if they were the children of his old age. Eagerly would he descant upon the difference between "lamellar distinct concretions"; how some were "indeterminate curved lamellar," others were "fortifications-wise bent." And then would follow the whole string of characters—"semi-hard," "not particularly difficultly frangible," "supernatant," "pretty cold," "not particularly heavy," between "aurora-red" and "hyacinth-red," or between "mountain-green" and "celandine-green." Such jargon it seemed to youthful ears! One could not but admire indeed its methodical precision, but the questions ever forced themselves on one's mind—What is the living truth underlying it all? Were minerals really created merely as a basis for our old friend's systems of classification? Or can they not be made to yield up some intelligible record of their own history and of the planet of which they form a part?

When the discoveries of William Smith drew off the attention of students to the marvels revealed by stratigraphical geology, mineralogy rapidly sank into neglect in this country. By a curious revulsion of opinion rocks were now appraised as of importance in proportion as mere mineral specimens were absent from them, for where these occurred organic remains were usually not to be looked for; and organic remains now took the place of minerals. Men who would formerly have trudged cheerfully a whole day with a 14-lb. hammer on their shoulders to secure a few minerals were now to be seen as enthusiastically hunting for ammonites, gryphaeas, belemnites, echini, fossil fishes, and other buried treasures of the stratified formations. Unmeasured was the scorn of the veteran mineralogist for this new-fangled pursuit. To neglect such attractive objects as minerals, with their exquisite forms and colours, for the dingy and fragmentary relics of extinct whelks, lobsters, and other pre-adamite vermin seemed to him an utterly unaccountable form of madness. And so his beloved cabinet became dearer to him than ever. In its quiet retreat he lived with his specimens in the past, and allowed the strong rising tide of palæontology to rush and roar past him unheeded.

But cycles appear in scientific as in political opinion For some years past there has been a growing conviction that palæontology has had a long enough monopoly of power in the geological commonwealth, and that the mineralogical side of the science has in this country been unduly neglected and discouraged. The attention now bestowed among us upon petrographical research is a pleasing proof of the reality and steady progress of this reaction Another token of the same change is supplied by the foundation and encouraging growth of the Mineralogical Society of Great Britain and Ireland This society was instituted in the early part of the year 1876. It counts among its members a large and increasing number of the best geologists in the three kingdoms. But its operations are carried on so quietly and unostentatiously that its work and aims are probably not yet so widely known as they deserve to be. A body gathered under the leadership of Sorby and Heddle is one which may count on support from all to whom the advancement of mineralogy and mineralogical geology among us is an object of interest. As a rule our scientific societies are bodies with a local habitation, gathering most of their effective members from the district in which their rooms are placed. But the Mineralogical Society, as its name denotes, embraces the whole United Kingdom. It has no buildings of its own nor any one special home. Its meetings, like those of the British Association on a large scale, are

held from time to time in different towns throughout the country, its object being to form a bond of union among those who cultivate mineralogy or who wish to see this science restored to the place which it ought to hold in a land where so much sound geological work is being done The Society publishes a "Mineralogical Magazine," of which three volumes and part of a fourth have already appeared. This publication contains numerous papers by Dr Heddle and the indefatigable secretary, Mr Collins, also some by Mr Sorby, the late Mr J C Ward, Prof. Bonney, and other well-known writers No one need fear to encounter in its pages the resuscitated ghosts of the old mineralogical "Dryasdusts" Peace to their manes! They did good though limited work in their day, which deserves our respect for its thoroughness. But, with affectionate reverence for these early masters and their crabbed lingo, we breathe a more open breezy atmosphere now. The mineralogist's ken sweeps far beyond the limits of his cabinet and laboratory. Hand-in-hand with the geologist and palæontologist, being elder brother to both, he takes his share in the task of unravelling the structure and history of the earth. Towards the attainment of this union the Mineralogical Society aims, and it deserves the heartiest wishes for its success

ARCH. GEIKIE

SMOKELESS LONDON

I WRITE for the purpose of expounding a scheme which, if adopted, would make London a smokeless city

When taking upon myself to explain a subject in a few minutes which has taken many years to develop in my own mind, there is a great temptation to put the reader in possession of the steps which led to the conclusion The conclusion itself however has so much to recommend it that I will confine myself to the results of my reasoning only. It is enough to say that they were arrived at to a great extent by an exhaustive exclusion of less feasible plans

First then I propose to take advantage of the existing plant of the gas companies I find they are amply sufficient for the purpose

Instead of taking 10,000 cubic feet of gas per ton from the coal, I propose to take 3333 cubic feet, and to pass three times the quantity through the retorts, or any other proportion that may be found most convenient. The result of doing so is startling

The companies will have double the quantity of by-products they have at present in the shape of tar and ammoniacal liquids, the community will have 24-candle gas instead of 16-candle gas; the fuel resulting from the process will light readily, and it will make a cheerful fire that gives out 20 per cent more heat than common coal, London would become a smokeless city

In dealing with the figures I shall take them roughly, but in such a way that by including a few outlying corporations they could be made absolutely correct.

I take the total annual consumption of coal in London to be 6,000,000 tons Of this I take 2,000,000 tons to be the annual consumption of the gas companies The total quantity of fuel used for general purposes I take to be 4,000,000 tons of coal and 1,000,000 tons of coke sold by the gas companies.

We shall now see what would be the result if we treat the whole of the 6,000,000 tons in the retorts on an extraction of less than three hours, instead of the six hours at present prevailing.

The total quantity of 16-candle gas consumed in London may be taken at 20,000,000,000 cubic feet. This would be at the rate of 3333 cubic feet per ton upon 6,000,000 tons, the total quantity of coal consumed in London. The residual smokeless fuel would amount to 5,100,000 tons. Of this 1,000,000 tons would be required for the extraction of the gas, leaving 4,100,000 available for the general uses of the community This has to be compared with the 4,000,000 tons of coal and the 1,000,000 tons of coke already referred to as consumed at present Now the smokeless fuel which results from an extraction of 3333 cubic feet of gas per ton has a heating capacity fully 20 per cent greater than common coal, and 10 per cent. greater than coke. This gives us the exact equivalents of the 5,000,000 tons of fuel at present in use

So far the account as regards the fuel available for the community balances. We may now deal with the difference in value between 16 and 24-candle gas As the value of the gas varies directly as its illuminating power, the calculation is very simple If we take the average price of 16-candle-gas to be 3*s*. 6*d* per thousand cubic feet we shall find the total value of the 20,000,000,000 consumed in London to be 3,500,000*l*, but as we have by my scheme the same quantity of 24-candle-gas, the value will be increased to 5,250,000*l*; here then we have an annual sum of 1,750,000*l* to place to the credit of the system.

Turning now to the by-products seeing the gas companies by the new arrangements would subject three times the quantity of coal to the heat of their retorts during the period when the tar and ammoniacal liquors pass off most rapidly, I do not think I am wrong in estimating the yield at double its present amount Taking this upon the tar and ammonia to yield 3*s*. 9*d* per ton of coal, we find the total value of these by products to be, at present, on the supposed consumption by the gas companies of 2,000,000 tons of coal per annum, 375,000*l* This being doubled under my scheme, an additional sum of 375,000*l* must be placed to its credit.

But the basis upon which we have hitherto been arguing is that the gas companies under the proposed scheme are getting their coal for nothing. We have been supposing that the community become the purchasers of 6,000,000 tons of coal and hand it to the gas companies At present London only pays for its general consumption on 4,000,000 tons of coal and 1,000,000 tons of coke. Let us now suppose that the companies pay the same sum annually that they do at present for their coals; if so, they would pay upon 2,000,000 tons, or an annual amount of 1,600,000*l*, if their coals cost 16*s*. per ton From this falls to be deducted the money they at present draw from their sales of coke, which, when taken at 6*s* per ton of coal carbonised under the existing system, still leaves a sum of 1,000,000*l*, which they could afford to pay per annum for the use of the 6,000,000 tons of fuel as proposed in my scheme. We will now take the total payments of the community for their coal to be upon 6,000,000 tons, for which we will further suppose they pay at the rate of 16*s* per ton first cost This would amount to 4,800,000*l* per annum From this falls to be deducted the 1,000,000*l* contributed by the gas companies for the use of the fuel, also the 1,750,000*l* charged on the difference between the 16- and 24 candle gas already referred to, also the sum of 375,000*l* of additional income from the by-products This would leave a net sum paid by the community for its fuel under my scheme of 1,675,000*l* Under the present system they have to pay, say 16*s*. per ton on 4,000,000 tons of coal, and say 12*s* per ton on 1,000,000 tons of coke This makes in all the sum of 3,800,000 per annum Here then we have a balance in favour of my scheme of 2,125,000*l* annually This may be taken as the yearly value of London smoke, which I propose to convert into useful products by *the plant at present in use*.

I have only in conclusion to say one or two words about the efficiency of the scheme as regards the fuel It lights easily, it gives off no smoke, it makes a cheerful fire, it gives out more heat than either coal or coke, it will be cheaper per heat-unit than the coal at present in use, London would become a smokeless city, and all that would fall to be deducted from the sum of 2,125,000*l*. per annum would be confined to a few items, such as the cost

of additional workmen employed in charging the retorts, interest upon additional capital required for transit appliances, and the terms to be made with the gas companies for carrying out the scheme [1]

I cannot close without acknowledging the help I have received from Mr. Wallace, the gas manager at Woolwich Arsenal, and the valuable information obtained from Mr Field's tabulated accounts of the London gas companies. So far as I am aware my contributions to the *Builder* and elsewhere are the only writing on the subject of my scheme that has ever been made public.

W. D. SCOTT MONCRIEFF

Westminster, December 13

NEW GUINEA [2]

OF the few travellers who have attempted to explore the great island of New Guinea, Signor D'Albertis must undoubtedly be considered the chief, since he alone has made extensive and repeated journeys both in the north-western and the south-eastern parts of the island, and has thus been able to examine and compare some of the most distinct tribes or races which inhabit the country. The narrative of his travels has therefore been looked for with some interest, for though several of his journeys have been more or less fully described in newspapers and magazines, it was felt that much must remain to be told, and that so energetic a traveller would probably be able to throw some fuller light on the hitherto doubtful affinities and relations of the Papuan races

Leaving Genoa in November, 1871, in company with the well-known traveller and botanist Dr. Beccari, and making short excursions in Java and the Moluccas, our travellers hired a small schooner at Amboyna in March, 1872, to take them to Outanata, on the south coast of New Guinea, and after some delays at Goram seeking a pilot and interpreter, on April 9 D'Albertis records in his journal. "A memorable day! At last I tread the mys-

FIG 1—Mount Yule Range, seen from Yule Island

terious land. At last, leaping on shore this morning, I exclaimed, 'We are in New Guinea!'"

Finding no safe or convenient place to stay at on the south coast, they proceeded to Salwati and fixed their abode for some time at Sorong, a small island close to the north-western extremity of the main land of Papua From this point they made excursions into the interior, and D'Albertis resided some time at the inland village of Ramoi, where he was near dying of dropsy and fever. They then went in a native vessel to Dorey Harbour, where they arrived in August, and sttled themselves at Andai Village, where a German missionary resides. Here they had a house built, which was their headquarters till November, and D'Albertis succeeded in spending some weeks at Hatam, a village on Mount Arfak, about 3500 feet above the sea, and in the midst of the forests inhabited by the finest and rarest of the birds of paradise. On the very day after his arrival here he shot both the shielded and the six-shafted paradise-birds (*Lophorina atra* and *Parotia sexpennis*), two species which had certainly never before been seen alive or freshly killed by any European; and before he left this spot he obtained many other rare species, besides an altogether new and beautiful kind, which has been named *Drepanornis albertisii*

Constant attacks of fever and dropsy, however, reduced him to such a state of weakness that it was absolutely necessary to seek a change of climate, and returning to

[1] By experiment I find that the greater heating power of the fuel in excess of the coke more than makes up for the cooling which takes place on account of the more frequent charging of the retorts

[2] "New Guinea What I Did and What I Saw" By L M D'Albertis, Officer of the Order of the Crown of Italy, &c., &c In two volumes (London. Sampson Low, Marston, Searle and Rivington, 1880)

Amboyna he was taken by an Italian man-of-war to Sydney, making some stay at the Aru Islands and South-Eastern New Guinea on the way. Thence he went home by way of the Sandwich Islands, San Francisco, and New York, reaching Europe in April, 1874, and thus terminating his first voyage to the far east.

When leaving Dorey in the end of 1872 he had determined to return to the north coast and to penetrate further into its forest-clad mountains, but the subsequent journeys of Dr Mayer, of which he heard at Sydney, and Dr Beccari's intention to return to the same district, induced him to turn his attention to the south, where he had obtained from the natives the skin of a new bird of paradise, and where the lofty ranges of Mount Yule and Mount Stanley offered the prospect of an equally rich and still less known exploring ground. Accordingly, in December 1874, he reached Somerset (Cape York) by way of Singapore, with the intention of settling at Yule Island, which he had before fixed upon as convenient head-quarters for the exploration of Southern New Guinea After some difficulty and delay he reached the island on March 17, and finding the natives friendly obtained permission to occupy some land and build a house Here he stayed till November, having with him a young Italian, two Cingalese, and five Polynesians, making large collections of natural history, exploring the island and the shores of the mainland, but being quite unsuccessful in his attempts to reach even the foot of the great mountains of the interior

This completes the first volume, which contains by far the most interesting matter both to the naturalist and to the general reader The second volume is devoted to a detailed journal of three successive voyages up the Fly River, the first in the missionary steamer *Ellangowan*, the two others in a small steam-launch, the *Neva*, lent him by the Governor of New South Wales On the second and most successful of these voyages D'Albertis penetrated to the very centre of the great southern mass of New Guinea, reaching the hilly country, but not the great central range of mountains, of which a few glimpses were obtained at a considerable distance.

The first impression produced by the careful perusal of these volumes is, that Signor D'Albertis has all the best qualities of an explorer—enthusiasm, boldness, and resource; a deep love of nature, great humanity, and an amount of sympathy with savages which enables him to read their motives and appreciate the good qualities which they possess To the character of a scientific traveller he makes no claim, and those who expect to find any sound generalisations from the results of his observations will in all probability be disappointed. Let us, however, by a few examples and illustrative passages, enable our author to speak for himself.

While residing at the village of Ramoi he became prostrated by fever, and was besides almost starving, for the natives would sell him nothing neither would they carry his baggage to enable him to return to Sorong Determining however not to die there without an effort, he sent for some of the chiefs to speak to him, and then grasping his loaded revolver assured them that unless they gave him men at once to assist him to leave the place not one of them should quit his hut alive The plan succeeded. One was allowed to go and fetch the men, the others remaining as hostages, and the revolver never left his hand till his baggage was all on board the canoe A little later when the travellers were on their way to Dorey, the native crew were very insolent, and boasted that when they reached their own country they would kill all the white men D'Albertis, hearing this, asked the man if he dared to repeat it, and on his doing so suddenly seized him by the throat and pitched him overboard. He was, of course, on board again in a moment, and instantly seized a bamboo to attack our travellers, but they exhibited their revolvers, and so cowed the whole crew that they became quiet and submissive for the rest of the voyage. An admirable portrait of one of these Dorey Papuans (Fanduri) is given, and the present writer can almost believe that he recognises in it one of his own acquaintances at Dorey in 1858.

More amusing was the way in which Signor D'Albertis made use of the aneroid on his journey to Hatam. His porters, who had agreed to take him there for a fixed payment, stopped at a village to rest, and on being told to go on, said, "This is Hatam, pay us our wages." He knew however, both by the distance and elevation, that that they were deceiving him, and told them so, but they again said, "This is Hatam, pay us How do you know that this is not Hatam?" He then took his aneroid out of his pocket, and laying his finger on a point of the scale, said, "Here is Hatam, this thing tells me where it is," and then explained that when they got higher up the mountain the index would move, and when they reached Hatam it would come to the point he had marked This astonished them greatly, but they would not believe it without

FIG 2—Fanduri, a Dorey Papuan

proof. So he let one of them carry it himself to the top of a small hill near, when they saw that the index had moved, and on coming down that it moved back againt This quite satisfied them. They acknowledged that the white man knew where he was going, and could not be deceived, so they at once said, "Let us rest to-day, tomorrow we will go to Hatam." Of course every man and woman in the village wanted to see the little thing that told the stranger where lay the most remote villages of the forest; and thus the traveller's influence was increased, and perhaps his personal safety secured.

In his second journey he provided himself with dynamite and rockets, which were very effectual in frightening the savages and giving him moral power over them. At Yule Island he was on excellent terms with the natives, on whom he conferred many benefits. Yet during his absence on an exploration his house was entered and a large quantity of goods stolen. In recovering these and firmly establishing his power and influence he showed great ingenuity. Calling the chiefs and other natives

together—who all pretended great regret at his loss, though the robbery must have been effected with their connivance—he told them that he was determined to have his property back, and that if it was not brought in twenty-four hours he would fire at every native who came within range of his house, which fortunately commanded a great extent of native paths, as well as the narrow strait between the island and the main land. He then made his preparations for a desperate defence in case he was attacked, loaded some Orsini shells and mined the paths leading to his house, so that with a long match he could blow them up without exposing himself. At the end of the twenty-four hours, nothing having been brought, he commenced operations by exploding five dynamite cartridges, which made a roar like that of a cannonade, the echoes resounding for several seconds. He then let off rockets in the direction of the native houses, and illuminated his own house with Bengal fire. All this caused terrible consternation, and the next morning the chief arrived with five men, bringing a considerable portion of the stolen goods, and trembling with fear to such an extent that some of them could not articulate a word. He insisted however that the rest of the goods should be brought back; and the next day, to show that he was in earnest, fired at the chief himself, as he was passing at a distance of 300 yards, being careful not to hurt, but only to frighten him. A canoe was also turned back by a bullet striking a rock close by it. The effect of this was seen next morning in another visit from the chief, with five complete suits of clothes, axes, knives, beads, and other stolen articles. Much more, however, remained, and D'Albertis took the opportunity of impressing them thoroughly with his power. He first asked them to try to pierce a strong piece of zinc with their spears, which were

FIG. 3.—Epa, a Village of the Mahon-papuans.

blunted by the attempt, while he riddled it through and through with shot from his gun. He also sent bullets into the trunk of a small tree a hundred yards distant, showing that a man could not escape him. They had been seated on a large stone near his house, which he had mined. He now called them away, and having secretly lighted the match, told them to look at the stone. A tremendous explosion soon came, and the stone disappeared. The natives were too frightened to move, and begged him to have pity on them, promising to restore everything. A great hole was seen where the stone had stood, while some of its fragments were found a long way off. For twelve days more he kept up a state of siege, turning back all travellers and many canoes by rifle-balls in front of them, but never hurting any one. Then another large instalment of his goods was brought, leaving little of importance, and ultimately he recovered almost everything. During the whole of this time he never hurt a single person or did any damage to their property, but succeeded in getting back his own by impressing them with his, to them, superhuman power. The result was that after eight months' residence he parted from these people on the best of terms. They all embraced him, and most of them shed tears, while their last words were "*Maria rau! Maria rau!*" "Return, Maria! Return, Maria!"—that being his second name, by which they had found it most easy to call him.

As a fearless capturer of snakes Signor D'Albertis rivals, if he does not surpass, the celebrated Waterton; indeed he seems to like them rather than otherwise. At Yule Island the natives had found a large snake under a tree, and all ran away from it, crying out, and this is his account of what happened.—

"At last I went to the natives and tried to ascertain

the cause of their conduct, and they made me understand why they had fled. I then returned to see the snake myself, which in fact I did, although two-thirds of its length were hidden in a hole in the earth His size was such that I concluded he could not be poisonous, and I at once grasped him by the tail. While dragging him out of his lair with my two hands I was prepared to flatten his neck close to his head with one foot the moment he emerged, so that he should not have the power of turning or moving. My plan succeeded perfectly, and while the snake's head was imprisoned under my foot I grasped his body with my hands, and, as though I had vanquished a terrible monster, turned towards the natives with an air of triumph They, struck with terror, had looked on at the scene from a safe distance. I must confess that the snake offered little resistance, although it writhed and twisted itself round my arm, squeezing it so tightly as to stop the circulation, and make my hand black. I remained however in possession of its neck, and soon secured it firmly to a long thick stick I had brought with me. I then gave the reptile to my men to carry home" This serpent was thirteen feet long, whereas the one Waterton caught single-handed was but ten feet, though it might have been equally powerful. This snake was kept alive and became quite tame, and when the natives saw D'Albertis kiss its head and let it coil round his legs they howled with amazement and admiration Six weeks after the capture he writes.—"My snake continues to do well; it has twice cast its skin, is well-behaved and tame, and does not attempt to escape, even when I put it in the sun outside the house, and when I go to bring it in, it comes to me of its own accord. It never attempts to bite, even when I caress or tease it While I am working I often hold it on my knees, where it remains for hours, sometimes it raises its head, and licks my face with its forked tongue. It is a true friend and companion to me. When the natives bother me it is useful in putting them to flight, for they are much afraid of it; it is quite sufficient for me to let my snake loose to make them fly at full speed" He kept this serpent for nearly six months, and latterly another of the same species with it, till at last both escaped, and he mourns their loss as of dear friends, adding, "for I loved them and they loved me, and we had passed a long time together."

The furthest village on the mainland visited by D'Albertis was Epa, where he lived five days, and of which he gives a very pleasing account. It is about 1500 feet above the sea, but a very short distance from the coast. The village is surrounded by a strong double stockade, and the people appear to be good specimens of the superior Mahori-Papuan race By the aid of these people it would probably not have been difficult to penetrate to the mountains of the interior, but our traveller was drawn away by the opportunity of exploring the Fly River, and has left the exploration of this grand mountain range with its rich natural treasures for some future exploration or some other explorer. Having thus sketched the outline of Signor D'Albertis' eastern voyages and indicated his main characteristics as a traveller and an author, let us see what he has to tell us about the people among whom he travelled.

ALFRED R WALLACE

(To be continued.)

PROF J. C. WATSON.

WE regret to have to record the death of Prof Watson, for many years director of the Observatory of Ann Arbor, Michigan, and later of the new Observatory established at Madison, Wisconsin, under the auspices of General Washburne

James Craig Watson was born on January 28, 1838, in Elgin County, Canada West, of American parents who were residing in Canada at the time of his birth While he was still a boy they removed to Ann Arbor, where at fifteen years of age he entered the University as a classical student, but his mathematical bias soon became evident He studied astronomy under Prof Brunnow, who was then in charge of the Ann Arbor Observatory, and Professor of Astronomy in the University, and while the latter was director of the Dudley Observatory at Albany, Watson occupied his place at Ann Arbor In 1860, when Prof Brunnow returned there, he was transferred to the Chair of Physics, which position he held until Prof Brunnow finally severed his connection with Ann Arbor in 1863, when Watson was again appointed director of the Observatory From this time his attention was chiefly directed to the discovery of minor planets, with which view he formed charts of very small stars, he had also in view the possible detection of an ultra-Neptunian planet, and it has been stated that latterly he had been more particularly working with this object, and had removed from Ann Arbor to Madison, to avail himself of the more powerful instrumental means at the latter place, where the refractor has an aperture of 16 inches, that of the Ann Arbor telescope being 12½. Watson added twenty-three members to the group of small planets, his first discovery being that of Eurynome in September, 1863

In 1870 Watson proceeded to Sicily at the head of a Commission appointed by the United States Government to observe the total eclipse of the sun on December 22, and in 1874 he went to Pekin in charge of a similar Commission for the observation of the transit of Venus. While at Pekin he discovered No 139 of the minor planet group, and it was stated at the time that the discovery was effected entirely through Watson's extraordinary recollection of the configuration of the small stars in the neighbourhood where the planet was situated (R A 0h. 58m. 15s, Decl. $+ 10° 44'$) A member of the Imperial family who had been asked to name the planet, called it the "Hope of China", *Juewa*, the name by which it has since been known, being an Anglicisation of the Chinese term.

Watson's observations of two objects during the totality of the eclipse of July 29, 1878, which he considered to be intra-Mercurial planets, will be fresh in the recollection of the reader there is no doubt that whatever opinion may have been entertained by other astronomers, he was himself convinced that he had met with planetary bodies, and he stoutly defended his opinion against the doubts raised in his own country

Watson was the author of a valuable work upon Theoretical Astronomy, published in 1867, upon which his reputation as an author mainly depends. He was a member of the principal scientific institutions of the United States, and his merits were acknowledged by several of the European Academies; he received the Lalande Medal of the Paris Academy of Sciences in 1870 for his numerous planetary discoveries.

The death of Prof Watson took place somewhat suddenly on the morning of November 23, at his residence on Observatory Hill, Madison, Wisconsin, and is attributed to intestinal inflammation, following upon a severe cold, in an overstrained condition of body he had been working hard as usual at night, while superintending the completion of the Observatory buildings by day He was buried at Ann Arbor on November 26; memorial services were held in the University hall, and were attended by a body of between seven and eight hundred students, and a large concourse of the general public, addresses being delivered by the President and several Professors of the University, of which the Ann Arbor and Detroit journals furnish lengthy reports.

NOTES

THE subscription opened by the Paris Academy of Sciences for raising a statue to M. Becquerel, the celebrated electrician, is almost closed, having produced 15,000 francs, only 1500 francs more are required. Those wishing to subscribe should send their contributions to M. Maindron, at the Academy of Sciences, as early as possible.

LAST week M. Moll, the *doyen* of the Professors of the Conservatoires des Arts et Métiers, died in Paris. He was the oldest teacher of agriculture and one of the first, having been one of the staff of the celebrated Rouville *ferme-école*, established about sixty years ago.

THE Nestor of German bryologists, Prof Ernst Hampe, died at Helmstedt on November 23 at the age of eighty-five years

ON Nov. 23 the first section of the St. Petersburg Academy of Sciences (physico-mathematical sciences) had to choose a member in chemistry, and an influentially-signed presentation recommended Prof. Mendelejef to the choice of the Academy. The Academy would certainly have done itself honour in choosing a man of such eminence in science, but we regret that Prof. Mendelejef was not elected This is held locally to show that the Academy is influenced in its selection by other reasons than the value of a candidate's scientific work. The impression on the public in general, we believe, is very unfavourable to the Academy, not a day passes, we are informed, that Prof Mendelejef does not receive letters and telegrams from men eminent in science expressing admiration for his works. Many scientific societies have made him an honorary member, and only the other day the University of Moscow did the same !

AN interesting collection is being made by M Dumas of medals commemorative either of scientific men or scientific discoveries The number already collected is far greater than had been expected.

LIEUT. JULIUS PAYER, one of the leaders of the Austrian North Polar Expedition of 1872-74, has settled at Munich with the intention of devoting himself exclusively to the art of painting.

THE central committee for the erection of a Spinoza monument at the Hague have, before their dissolution, resolved to utilise the remaining balance of funds in their hands for publishing a new and handsome edition of the complete works of the great philosopher. Doctors J. van Vloten and J. P. N. Land have been commissioned to prepare the new edition. In the interest of this laudable undertaking the friendly request is now addressed to all librarians and possessors of autographs to communicate with these gentlemen regarding any autographs of Spinoza which may be in their possession, in order to render the edition as complete as possible. Communications are to be addressed to the publishing firm of Martinus Nijhoff at the Hague

A STRONG shock of earthquake was felt at Wiesbaden on the night of the 8th instant, at eleven o'clock; the shock was directed from north to south. A strong subterranean noise preceded it, and a violent wind of short duration was observed. Another shock is reported from Saxony A fresh violent shock lasting two seconds occurred at Agram at twenty-seven minutes after midnight of the 7th. Subterranean rumblings followed the shock and continued to be heard throughout the night. As on the last occasion the shock was accompanied by distant storms and preceded by a slight vibration On Wednesday night last week there was a strong earthquake shock at Agram which lasted six seconds. It was preceded by a loud rumbling. On the day previous the earth trembled for an hour together. That of Wednesday night was the strongest shock since the first. Two walls fell in and the houses shook. On Thursday evening last six slight shocks were felt at Vienna. At Agram there were two violent shocks at half past two and half-past three o'clock in the morning. A shock of earthquake was felt at Brescia on the afternoon of the 10th, accompanied with a rumbling noise.

PROF. RUDOLPH FALB gave a lecture in the Vienna Gewerbe Museum on November 27, in which he said that earthquakes are subterranean volcanic outbreaks, produced by the cooling action of the hot liquid interior of the earth and the attraction of the sun and moon. In support of this view he urged that most earthquakes occur at the time when the sun is nearest us, viz, in January, fewest in June, also the number of earthquakes increases in the months of April and October, because of the stronger attraction of the sun on March 21 and September 23 He said further that in the period December 16-30 this year fresh earthquakes might occur at Agram.

A NEW and somewhat bold hypothesis as to the cause of earthquakes has been propounded by Dr. Novak in Pesth. He considers that, besides the rotation of the earth on its axis and its revolution round the sun, a multiplicity of motions of the earth appear in space, in virtue of which the earth's axis, and with it the equator, shift their position. This causes a variation of the forces influencing the earth's form (centrifugal and centripetal force), and the earth has the tendency to adapt itself to this change He also considers a change of form of the earth to occur through the shifting of the pole and the equator, and that this may have effect some time afterwards, where the earth's crust is weak.

WE are requested by the Sunday Society to announce the following arrangements for the Sunday opening of the Winter Exhibition of Oil Paintings at the Hanover Gallery, New Bond Street, by permission of the proprietor, Mr. Weil. On Sunday, December 26, the Gallery will be open to the Members of the Society, and on the two following Sundays the public will be admitted by free tickets, which will be issued to those applying by letter and sending a stamped and addressed envelope to the Honorary Secretary, 8, Park Place Villas, W On each Sunday ticket-holders will be admitted from 4 o'clock till 7 30 p.m., and the gallery will be closed at 8 o'clock. On the reassembling of Parliament the Society will press its claims upon both Houses of the Legislature by bringing forward the following resolution :—"That inasmuch as all opposition to the action of Her Majesty's Government in opening on Sundays the National Museums and Galleries in the suburban districts of London and in Dublin has entirely ceased, owing to the good results which have followed such opening, this House is of opinion that the time has now arrived for extending this action to all institutions of a like character, it having been most conclusively shown that large numbers of the people rejoice in every opportunity that is afforded them of spending Sunday intelligently and with due regard for its preservation as a day of rest and cessation from ordinary work and amusement."

SOME information regarding the observatory at Nice, now in course of construction through the munificence of M. Bischoffsheim, is given by M. Tissandier in *La Nature*. Some 35 hectares of ground have been acquired. The situation is a few kilometres north-east of Nice, near the road from Corniche over the Mont des Mignons (or Mont Gros), and 375 m. above the sea There are to be two large dwelling-houses for astronomers and for accommodation of visitors. One is already finished, and M. Thollon has there done some excellent work in spectroscopy. More than 250 workmen are at present busy on the buildings. Some of the instruments will shortly be ready The whole is being organised under the auspices of the Bureau des Longitudes.

The Observatory will comprise at first two equatorials, one meridian, and several accessory instruments. One of the equatorials will probably be the largest astronomical apparatus in the world. Its focal distance will be 18 metres, and its aperture 0·76 m. The cupola will have a diameter of no less than 22 m. The construction of the object glass is entrusted to MM. Paul and Prosper Henry of the Paris Observatory. The instrument alone will cost about 250,000 francs, and the cupola will be correspondingly expensive. The total cost of the Observatory will exceed two million francs.

AN interesting pamphlet on the subject of the introduction of hypotheses in school education has been published by Dr. Hermann Muller of Lippstadt (Bonn, Strauss). Dr. Muller writes in self-defence and in reply to Prof. Virchow, whose controversy with Prof. Hackel on this subject some years ago will be remembered.

AMONG other useful matter in the "British Almanac and Companion" for 1881 is a summary of the science of the past year, by Mr. J. F. Iselin, which is good so far as it goes, but that is necessarily not very far. There is also an article on "Weather Forecasting," by Mr. R. H. Scott, and a "Sketch of the History of the Royal Observatory, Greenwich," by Mr. W. T. Lynn.

THE Report of Mr. Morris, the Director of Public Gardens and Plantations in Jamaica, on the financial results of the last consignment of Cinchona barks sent to the London market, is extremely satisfactory, inasmuch as it shows the superiority of Jamaica barks over those of Ceylon, as indicated by the prices realised. The consignment referred to in the present Report consisted of eighty-one bales, in which the several species under cultivation were represented, crown bark from *C. officinalis* and red bark from *C. succirubra* forming by far the largest proportion. The total amount realised for these eighty-one bales was 1313*l.* 11*s.* 7*d.* For all the different kinds, whether "quill," "trunk," "root," or "twig" bark, the prices realised were in excess of those obtained for the same kinds of Ceylon barks, to the extent even in some cases of 2*s.* 9*d.* per pound. Mr. Morris draws attention to the fact that from the recent sales the relative merits of the two principal species under cultivation, namely, the crown or grey bark (*C. officinalis*) and the red bark (*C. succirubra*) have become very distinctly marked. The first named species has proved to be a most valuable product, and whatever changes and fluctuations may ultimately take place in view of the more extensive cultivation of Cinchona in different parts of the world, high-class bark of this nature must always command good and remunerative prices. The conclusion arrived at is that the conditions of soil and climate of certain parts of Jamaica are "eminently favourable to the production of the best qualities of these valuable products, and as large tracts of land and the necessary labour are now available, there are only wanting sufficient capital and energy to overcome the initial difficulties of this enterprise."

THE buds of the second vegetation in Paris which we noticed in October were killed by the frosty weather in the beginning of November, but a new vegetable phenomenon has been seen in the Champs Elysées. Owing to the exceptional hot weather prevailing in December new leaves have been observed on a few trees, and were flourishing at the date of our most recent observations.

THE Bill relating to the forthcoming exhibition of electricity in Paris has been presented to the Chamber. M. Cochéry asks for a credit of 300,000 francs—150,000 for the exhibition and 150,000 for the Congress and experiments. A guarantee fund of 20,000*l.* has been signed by fifty persons.

A USEFUL pamphlet on Bedroom Ventilation has been published by Mr. Lawson Tait of Birmingham.

THE *American Entomologist* has been incorporated with the *American Naturalist*.

THE rare phenomenon of an inverted rainbow was observed at Innsbruck on November 25 at 8.45 a.m. The end points of the semicircle, the centre of which was the sun, rose and moved westwards with the latter for some thirty minutes. The phenomenon then vanished.

A VALUABLE discovery has been made at Jochenstein, near Obernzell (Bavaria). A farmer of Jochenstein had frequently noticed a stone plate, of some 1½ metres square, in the centre of a wood belonging to him. He had the plate raised recently, and under it were found six head-rings, four spiral bracelets, each showing nine twists, and two battle-axes. All the objects are of bronze and capitally preserved.

THE second part of "The Scientific English Reader" (Leipzig, Brockhaus), edited by Dr. F. J. Wershoven, the first part of which we have already referred to, contains extracts relating to machinery and mechanical technology.

THE fourth part of Dr. Dodel-Port's excellent "Atlas of Physiological Botany" has just been published. The six plates it contains are in every respect equal to those of the former numbers. They comprise (1) *Volvox minor*, germ-history of the oospore (this plate forms the supplement of the *Volvox globator* plate in part 1), (2) *Equisetum Telmateja*, sporangia and spores; (3) *Passiflora cœrulea* and *P. cœruleo-alata*, (4) *Selaginella helvetica*, with macro- and microsporangia, macro and microspores; (5) *Polytrichum gracile*, male and female plants, moss-fruit and its anatomy, spores and germinating spores, (6) *Narcissus poeticus*, seed-bud in longitudinal section at the time of fertilisation. These drawings are made according to the latest researches on the fertilisation of phanerogamic plants. Parts 3-5 of the same authors' "Illustrirtes Pflanzenleben" will also shortly be published.

AMONG the special papers in the *Annuaire* of the Brussels Observatory for 1881 are the following:—"What is the Climate most favourable to the development of Civilisation?" "Physical Phenomena accompanying the Transits of Mercury," by M. Niesten; "Nomenclature of existing Public Observatories"; "The Asteroids," by M. Niesten; "The Isthmus of Panama."

THE last Calcutta *Gazette* contains some official correspondence regarding the insect lately discovered in Monghyr, which threatens to become very destructive to the rice crops. The specimens forwarded to Mr. Wood Mason, deputy superintendent of the India Museum, have been identified by him as belonging to the genus *Cecidomyia* and as related to the Hessian fly which ravaged the wheat-fields in the United States. This genus, Mr. Mason says, has never before been found in India, and he proposes to call the species *Cecidomyia oryzæ*, or the rice-fly. He goes on to say that it is likely to prove a most formidable pest, and recommends that the district officers should be instructed to make further inquiries and carefully watch its progress.

A RECENT number of the *Golos* contains an interesting letter from Tiflis describing the enormous labour bestowed during the summer upon the destruction of the grasshoppers. The work was carried on for about three months, and occupied in one district (Gori) no less than 20,000 people per day. More than half these people had been summoned from the neighbouring districts of Achalzych, Ossetia, and Imeretia. Thanks to the colossal efforts thus made only 2 per cent. of the total crops of the district were destroyed by the grasshoppers. Many million roubles worth of hay and corn were saved by this work. On the other hand the organisation of the whole cost the Russian Government some 200,000 roubles, and many thousand acres of fields and gardens have been utterly neglected by the population to whom they belong.

A Rhenish Fishery Society has just been founded at Cologne. It will direct its attention not only to the Rhine fisheries, but its programme is a most universal one, comprising even the furtherance and support of ichthyological research as well as the establishment of ichthyological stations in various countries.

Mr. Baller of the China Inland Mission has lately made a journey in the little-known province of Kweichow at the time when the people were engaged on their opium harvest, and he thus describes the process :—A small three-bladed knife is used to make an incision in the poppy-head as soon as the petals fall off. The drop or two of milky juice that oozes out is after a little while scraped off with a small curved knife into a bamboo tube, and a fresh incision made. The process is repeated until the supply is exhausted. The juice thus collected is dried in the sun, when it turns jet black, and is then ready for the market

OUR ASTRONOMICAL COLUMN

The Comets of Hartwig and Swift.—MM. Schulhof and Bossert have investigated the elements of comets 1880 *d* and *e*, discovered respectively by Dr Hartwig at Strasburg on September 29, and Mr Lewis Swift at Rochester, New York, on October 11. Prof. Winnecke had conjectured that Hartwig's comet might have been identical with the comets of the years 1382, 1444, 1506, and 1569, with a period of revolution of 62¼ years MM. Schulhof and Bossert formed six normal positions between September 30 and November 29 from observations at Paris, Strasburg, Berlin, Leipsic, Kiel, Kremsmunster, Lund, Florence, Marseilles, O'Gyalla, Clinton, and Washington, and on varying the distances from the earth at the first and fifth place until the other normals were represented as closely as possible, arrived at an elliptical orbit, but with a period of 1280 years: this result is necessarily uncertain under the circumstances, but it nevertheless appears to render so short a revolution as 62¼ years in the highest degree improbable

With respect to Swift's comet, taking as the fundamental data the Odessa observation on October 31, a mean of Dunecht, Paris, and Strasburg on November 9, and an observation at Paris on November 27, it is found that, assuming only one revolution to have been accomplished between 1869 and 1880, or that the period is 10·96 years, the middle place cannot be represented with sufficient precision, when the error is diminished in longitude, it is increased in latitude. On the hypothesis that the period is 5½ years, or that two revolutions are included in the above interval, the error in latitude is greatly diminished, but still exceeds thirty seconds of arc. This, while indicating that the second hypothesis is more probable than the first, is regarded by MM. Schulhof and Bossert as rendering so short a period as 3⅔ years possible, though it is admitted that it may well be due to errors of observation It must be borne in mind that the comet has always presented itself as a faint diffused object, without that degree of condensation necessary to insure precise observation The following is the ellipse of 5½ years' period —

Perihelion passage, 1880, November 8·00011 G M.T.

	°	′	″	
Longitude of perihelion	43	4	33	M Eq. 1880·0
,, ,, ascending node	296	51	33	
Inclination	5	23	32	
Angle of excentricity	41	3	25	
Logarithm of semi-axis major	0·492684			

With these elements the perihelion distance will be found to be 1·0671, and the aphelion distance 5·1518, and the heliocentric latitude at aphelion − 4° 6′·6, whence we find the distance from the orbit of Jupiter to be 0·53.

MM. Schulhof and Bossert propose to continue their investigation when further observations are available: meanwhile it may be remarked that their ellipse of five and a half years is likely to afford positions sufficiently near the truth to insure the observation of the comet as long as it is within reach of our telescopes, and it may be suggested to those who are in possession of powerful instruments that they will render an important service in determining places of this comet as long and as accurately as practicable

The November Meteors.—Notwithstanding much interference from clouds the observers at Moncalieri, who watched for meteors during the nights of November 12-14, consider that they obtained evidence of the increasing density of the Leonid-stream, thus confirming observations made last year in England and the United States. One of these meteors appeared larger than the planet Jupiter, with an intense blue light, and a bright train of the same colour It is added: "La lumière zodiacale d'opposition était très brillante vers l'orient, sur le fond pur de ciel, s'élevait jusqu'au delà de la queue de Lion."

Near Appulse of Jupiter to a Fixed Star.—On the evening of November 20 Jupiter must have approached very near to the star B.D. + 2° No. 97, rated 7·7 in the *Durchmusterung*, and 7·9 on December 17, 1856, when it was observed on the meridian at Bonn, indeed the resulting place of the star would bring it almost into contact with the limit of the planet about the time of conjunction in right ascension (9h 4m.), but small errors of the star's position and tables of Jupiter may have combined to leave it at an appreciable distance from the limb, perhaps some reader of Nature may have determined micrometrically the nearest approach. The apparent place of the star on November 20 was in R.A. 0h. 38m. 49·44s., Decl. + 2° 32′ 59″·9.

BIOLOGICAL NOTES

Anabæna living in Botrydium.—It is now well known that many plants belonging to the group of the Nostocs flourish within the cells of other plants Thus they are to be found in the petioles of the leaves of Gunnera, in Lemna, in Anthoceros, in Blasia, and in Azolla, and it was to be expected that they would equally find themselves at home in the cells of even more lowly organised plants An instance of this latter, not without interest, has been noticed by Dr L Marchand, who recently collected a Botrydium at Montmorency, which, on being examined under the microscope, was found, instead of containing the usual mass of granular chlorophyll, to be filled with a chain of moniliform filaments, presenting all the characters of the chaplets of a Nostoc or Anabæna. These filaments were composed of cells, some oblong with yellowish heterocysts, and they did not fill the entire cavity of the Botrydium cell, but seemed to adhere to its inner walls. The Botrydia plants were perfect; the root like prolongations, as well as the rest of the plant, were perfectly closed. How then did these foreign bodies get in? This is not a question easy to answer, but it is one well worthy of being investigated. Dr. Marchand calls attention to the remarkable figure of Mr F. Parfitt in "Grevillea" (vol. i. p 103, pl vii), in which there is now little doubt, with the light thrown on the subject by Dr. Marchand's specimens, that there is represented our common species of Botrydium with a parasitic, or better, an endophytic Anabæna. No doubt the cells of the Anabæna in Parfitt's figure are badly represented, but the observation made in Parfitt's paper would seem now not to be without a special interest of its own.

Mesembrianthemum not Mesembryanthemum.—Prof. Asa Gray, in the *Botanical Gazette* (Indiana), vol. v. Nos. 8 and 9, p. 89, thus writes:—This word is properly written Mesembrianthemum, by Jacob Breyne, who made the name, and by Dillenius, who took it up, both giving the derivation from *Mesembria*, mid-day, alluding to the time in which the blossoms open. But both Breyne and Dillenius themselves very often wrote it Mesembryanthemum, Linneus, adopting this latter, became consistent by making a wrong and far-fetched derivation to match the orthography Among systematic writers Sprengel almost alone keeps to the correct orthography, but Webb insists on it. The younger Breyne, in his edition of his father's "Prodomus," has a note about it (p. 81). He mentions an excuse for changing the orthography, namely, "that some species do not open their blossoms at noontide," but intimates that Linneus' derivation from the insertion of the corolla around the middle of the germ is open to the same objection. Prof. Asa Gray adds, "if heeded, this kind of objection would be fatal to very many generic names."

Chlorophyll in the Epidermis of Plants.—Adolf Stohr contributes to the *Scientific Proceedings* of the Vienna Academy a very interesting paper on the occurrence of chlorophyll in the epidermal tissue system of the leaves of flowering plants. He sums up a detailed account as follows:—While the epidermis of the aquatic submerged Phanerogams is usually regarded as containing chlorophyll, the epidermis of the green organs of the terrestrial Phanerogams is, on the contrary, considered to be

destitute of chlorophyll. This at least is the most prevalent view. Exceptionally, submerged Phanerogams are found with an epidermis destitute of chlorophyll, and there are also some exceptions to the general rule quoted about the leaves of terrestrial Phanerogams. Now it happens that the at present prevailing view is only right in one respect, for up to the present, observations prove the regular appearance of chlorophyll in the outer layer of submerged Phanerogams. The second half of the prevalent view should be completely reversed, for the appearance of chlorophyll in the epidermis of the green organs of Phanerogams is the rule, and with few exceptions. The results of Stohr's researches lead to the following:—1. The epidermis of the green organs of the broad-leaved Gymnosperms, and of by far the most of the terrestrial Phanerogams, contains chlorophyll. 2. Chlorophyll appears regularly to be absent from the green organs of the needle-leaved Gymnosperms and the terrestrial Monocotyledons. 3. Chlorophyll is in most cases only to be found in the under surface of the leaves, but is also to be met with in the leaf-petioles and stipules. It remains in such position during the whole life of the organ. 4. Chlorophyll is seldom to be found in the upper and lower surfaces of the leaves at the same time. In most cases one can see that the chlorophyll of the cells of the epidermis of the upper surface of the leaf is quickly destroyed upon its formation, by the effect of a too intense light. 5. So far as the process of the evolution of the chlorophyll bodies was observed, the latter showed themselves as starch-chlorophyll bodies. M. Stohr gratefully acknowledges that these investigations were undertaken at the suggestion of Prof. Wiesner, the author of a memoir, "Ueber die naturlichen Einrichtungen zum Schutze des Chlorophylls der lebenden Pflanze." The leaves of nearly one hundred species of plants were carefully examined, and full details of these examinations are given in the tables that accompany M. Stohr's memoir. The investigations were carried out in the botanical-physiological laboratory of the University of Vienna. (*Sitzungsberichte d. k. Akad. Wissenschaften—mathem.-naturw. Cl.*, 79 Bd., S. 87.)

Blood Vessels of Valves of the Heart.—Recent researches by Dr. Langer (Vienna Acad. *Anz.*) prove that several mammalian genera (pig, dog, bullock) have a fully-formed blood-vascular system both in the semilunar and the atrioventricular valves. On the other hand an examination of about 100 human hearts (of children and adults) discovered blood vessels in the heart-valves only in one case, that of a woman of sixty, in whom they were evidently the result of a pathological process. Dr. Langer explains the difference by a difference in the mode of formation of the valves.

Light and the Transpiration of Plants.—Dr. Comes (Naples Academy) finds, *inter alia*, that light favours transpiration; that a little after midday transpiration is at its maximum; that, other things equal, that organ transpires most which is most intensely coloured, and it emits most water when exposed to that part of the solar spectrum where it absorbs most light; and that only those luminous rays which are absorbed favour transpiration of an organ (not the inactive rays); so the transpiration is minimum under the rays coinciding in colour with that of the organ, and maximum under the complementary rays.

Pinguicula Alpina.—Prof. Klein of Buda-Pesth publishes in the last part of Cohn's *Beiträge zur Biologie der Pflanzen* an interesting memoir on this plant. 1. It appears in two forms: one has bright green leaves, the other has more or less reddish-brown coloured ones. These forms however appear only to possess the value of local varieties. 2. *Pinguicula alpina* is, like the other species of Pinguicula, an insectivorous, *i.e.* flesh eating plant, but is partly also a plant eating one. 3. Its roots are simple, *i.e.* they do not branch, and they possess notwithstanding a pericambium. The cells of the bast layer have handsome, for the most part doubly-ridged longitudinal walls, and are the first formations that differ from the primary meristem of the end of the root. The greatest part of the root remains in respect to the tissue formation in an undeveloped and almost embryonic condition. 4. The caulome contains between the pith and bark a vascular ring which is characterised by very short-jointed vessels; these joints are bound together at the points of contact, and their cross walls are broken through by one single circular opening. The bundles of vessels belonging to the roots spring partly out of the caulomic vascular ring, partly out of the leaf-spur. 5. The original bending in of the edges of the leaves can be regarded as an advantageous arrangement in respect to the catching of insects, as insects cannot easily get over the edge of the leaf, and can therefore also be generally caught under it. 6. The cells of the epidermis of the leaf contain no chlorophyll, but the green-leaved specimens contain a colourless sap and the red-leaved ones a reddish sap. Besides they always possess a cell nucleus in which crystalloids are to be found. 7. The edge of the leaf is transparent, and consists of a single row of epidermis cells. 8. The epidermis of the leaves contains as well on the upper as on the lower side tolerably numerous stomates, which are only wanting on the outermost edge. Their manner of formation corresponds mostly to that observed in Thymus; it shows however some deviations. The stomate is surrounded by a narrow edging which is more strongly cuticularised than the outer walls of the epidermis cells. The cells of the stomates contain no crystalloids, but only a few very small chlorophyll bodies. 9. The epidermis of the upper surface develops two kinds of glands with and without stalks. The glands with stalks consist of a basal cell projecting above the epidermis; out of this proceeds a one to four-celled half spherical columella, on the top of which a glandular body, consisting of a layer of radially-placed cells, is placed cap-like; the stalkless glands are similarly built, only the stalk is wanting, the columella is conical, and the glandular body does not as a rule project more than half over the epidermis. The process of development is similar in both glands. 10. Stalkless glands appear also on the lower side of the leaf. They are only feebly developed, and their cap portion hardly projects over the epidermis. From their presence it can be deduced that the various kinds of Pinguicula once only possessed stalkless glands; from which in process of time both the stronger developed stalkless glands and those also with stalks became developed on the upper side of the leaf, by which the capacity of the leaves for catching and digesting insects was at the same time perfected. In connection with this, one can infer a somewhat similar theory about Utricularia and Aldrovanda, and even about Dionæa and Drosera. 11. The bundles of vessels belonging to the leaves are branched out in netlike veins, and anastomose chiefly with one another. The veins at the ends unite near the edge of the leaf into a sympodial layer, from which numerous veins go out directed to the edge of the leaf and end in enlarged spirally thickened cells, which cells sometimes border directly on the epidermis cells belonging to the edge of the leaf or are separated from them by one or more cells. 12. The tracheal vessels of the leaves, as well as of the other parts of *Pinguicula alpina* never contain air, but either a watery fluid or a yellowish-brown resinous-looking substance. This circumstance, together with the strange branching of the tracheal vessels in the edge of the leaf particularly adapted to catching insects seem to prove (or show) that the tracheal vessels serve for the transport of a substance that stands perhaps in direct connection with the function of the leaves. 13. The mesophyll cells form among one another tolerably large interstices filled with air, and contain generally chlorophyll bodies in abundance. 14. Starch is to be found in the chlorophyll bodies of *P. alpina*, and also in the small stems and roots of the hybernating plants, when it appears in small compressed nuclei. 15. Glands with and without stalks appear in the flower stalks as well as in the flowering parts.

GEOGRAPHICAL NOTES

At a meeting of the Geographical Society on Monday evening Capt. T. H. Holdich, R.E., of the Survey of India, read a very interesting paper on the geographical results of the Afghan campaign, in which, after giving a sketch of the features of the country, he summed up the additions lately made to our knowledge. These are very considerable, for in the last two or three years he and Major Woodthorpe with their staff have surveyed and mapped from 25,000 to 30,000 square miles of country. Some of the more important facts ascertained are the facility with which practicable roads can be made through the passes of Afghanistan, and the comparatively low elevation of those of the Hindu Kush, which, according to Capt. Holdich's view, would offer no real barrier to the advance of a properly-equipped army. Capt. Holdich hinted that the further mapping and survey of the country were being continued by native explorers attached to the Survey of India, and he thought that in a few years' time it would be known from end to end, and that our surveys would then join on to those of the Russians north of the Hindu Kush. Capt. Holdich remarked also on the curious intermingling of races in some parts of Afghanistan, and in the ensuing discussion Mr. Blanford, late Director of the Geological

Survey of India, made some valuable observations on certain points connected with soil-formation, &c., in Central Asia

UNDER the title of "Die geographische Erforschung des afrikanischen Continents von den ältesten Zeiten bis auf unsere Tage," by Dr. Philipp Paulitschke, Messrs. Brockhausen and Brauer of Vienna have published a volume of 320 pages, containing a brief but full sketch of the progress of African exploration from the earliest times down to the present day. Its special value consists in the detailed bibliography of the subject contained in the footnotes on every page, which must be of the greatest service to the student of African exploration and geography. There are occasional slips, as when Mr. Monteiro's book on "Angola and the River Congo" is entered under "Monteiro," as published in New York in 1875, and again under "J John," as published in London in 1876 But such blunders are wonderfully few About 1500 names are referred to altogether.

DR. LENZ, on November 22, was at St. Louis, whence he was going to Tangier

AS a memorial of the work performed in the *Vega*, a "*Vega* Fund" has been raised by subscription in Sweden to encourage further geographical research. The sum raised is 35,000 crowns, which will be intrusted to the Swedish Academy of Sciences, and the interest either employed at once or be allowed to accumulate for a term of years Only natives of Sweden, Norway, Denmark, and Finland will be entitled to receive the benefit of the fund.

TWO important expeditions are soon to be sent into Central Africa, under the auspices of the Algerian Missionary Society, which already has stations at the northern ends of Lake Tanganyika and the Victoria Nyanza One will go from Zanzibar, and the other will ascend the Congo.

THE INFLUENCE OF PRESSURE AND TEMPERATURE ON THE SPECTRA OF VAPOURS AND GASES[1]

IN the course of my inquiry last year into the homology of the spectral lines of chemically-related elements I occasionally made the observation that the two strongly-marked red lines which bromine in the fluid state gives when the spark is taken from it in De la Chanal's fulgurator grow very feeble or entirely disappear in the spectrum of the rarefied vapour in the Geissler-tubes, while other lines not previously seen become visible. It appeared to me of interest to inquire more particularly into the changes of the spectrum of one and the same element, as these changes are naturally of the greatest importance in the comparison of chemically-related elements, and with this view I addressed myself to the problem of the changes of spectra at higher pressures.

According to Wullner's well-known experiments, which only deal with the three permanent gases, hydrogen, oxygen, and nitrogen, the spectral lines of the second order grow broader with higher pressure, and at the same time a continuously illuminated background is to be observed This phenomenon, however, presents even in the three permanent elements the greatest difference Thus, while the lines in the hydrogen spectrum become easily broader even under moderate pressure, those in the spectrum of nitrogen do not expand. Therefore it occurred to me that a comparative investigation, which would extend to as many elements as possible, would be desirable, inasmuch as it encouraged the hope that by this means one could arrive at a law, perhaps even at an explanation, of these phenomena.

I now venture to present to the Academy a report of my experiments as far as they have gone, reserving a full account till their completion.

In my experiments I have treated the most volatile of the metalloids, and among the metals have included quicksilver and sodium. I will in due time give a full account of the apparatus and methods which I employed in my experiments, but at present I must confine myself to a statement of the results already ascertained.

The spectrum of the three halogens, at higher pressures, exhibits in each case the same peculiarities. The lines have the appearance of merging into each other, and without showing an expansion into bands, they become occasionally somewhat broader. There is a steadily luminous background which becomes brighter when the pressure is increased, and which is often more intense than the lines themselves. This latter circumstance is frequently seen in the case of iodine, where the continuous spectrum finally covers all the rest In the case of chlorine and bromine single lines are always distinguishable from the continuous surrounding light The appearance of certain lines in the red field in chlorine and bromine which always preserve their precision and delicacy is worth mentioning.

The changes in the intensity of the spectral lines as exhibited under different pressures are very interesting If you compare the spectral lines of the halogens with each other, in order to ascertain their homology, and in doing so only employ the spectra of rarefied vapours in Geissler tubes, you meet considerable difficulties, for you can only compare the lines in groups, and these lines present frequently in each of the three elements such differences of intensity that you may be left in doubt as to the existence of a homology of their lines. But the apparent differences arise in reality out of the variation of intensity and the number of the lines with the pressure. By appropriate change in the density of the gas or vapour you can always produce spectra which exhibit the perfect homology of the lines. Thus, in the case of iodine you must employ that tension which iodine-vapour has at 50° or 80° C, while in the case of chlorine and bromine atmospheric pressure is required.

The spectrum of sulphur does not change at all at higher pressure, the lines maintaining their perfect sharpness, while in the red field a continuously illuminated background appears.

Phosphor and arsenic do not give any reaction, and even the continuous spectrum does not appear. With arsenic I observed what I think has hitherto been overlooked, namely, that it gives at a moderate pressure, and without the interposition of a Leyden jar, *a spectrum of the first order*. It is almost continuous, and with increase of pressure of interposition of the jar it gives to the spectrum of lines the spectrum of the second order

Great is the difference between the metalloids of which we have hitherto been speaking and the metals, they show an expansion of their lines into bands, while the continuous light takes a less prominent place In quicksilver the breadth especially of the green and violet lines is conspicuous.

With sodium I have only noticed the great width of the D-lines when they appeared reversed, for I could only examine the light after its passage through a layer of cooler vapour Sodium gives at high pressures a continuously illuminated spectrum near the D-lines, which then appear reversed, at first one or two lines, but soon they widen and merge into each other, and the dark band of absorption gradually covers the whole illuminated part of the field.

[1] By G Ciamician, in *Sitz Ber der k Akad der Wiss*, Vienna, lxxvii Band, v. Heft.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—Prof Stuart finds the progress of his School of Mechanism and Engineering again compels enlargement. Some pupils are now making small engines, and require more space for erecting them. A room for mechanical drawing is needed, and also an enlarged stove The Museums and Lecture-rooms Syndicate think it best in the present condition of University funds to erect a new temporary building 46 feet long by 21 feet wide, adjacent to the present workshop, and this, with other rooms which can be added, will supply present necessities for about 360*l*.

The balance of 821*l*, being the debt on the last two years of the Museums Maintenance Fund, has been granted as an extra payment from the University Chest, and in future years 3000*l*. will be granted annually for the Museums and Lecture-rooms Maintenance Fund.

Prof. Stuart is to have the services of a Demonstrator of Mechanism and Applied Mechanics

Clare College announces a scholarship of 60*l*. a year in chemistry and chemical physics, botany and geology, to be competed for on March 29 next, without limit of age. Jesus and Magdalene Colleges continue to offer no inducements to natural science.

BY a Royal decree, published last month, a museum will shortly be opened at Palermo on the plan of the one founded in Rome in 1874, with the object of making known the best scho-

lastic materials and best didactic methods adopted with success by the most cultivated and civilised nations. This museum is styled the Pedagogic Museum, and will have its seat in the Royal University. Its aim is to collect, with a view to their recognition and adoption, all objects and publications connected with the mode of instruction in elementary schools, and in general all the new means and appliances which are being successively invented to insure greater efficiency and progress in the arts of instruction and education. All that has till now been collected by the Professor of Pedagogy in the present Museum of Palermo will henceforth belong to the new institution, which is dependent on the Minister of Public Instruction.

SCIENTIFIC SERIALS

THE *Journal of Anatomy and Physiology, Normal and Pathological*, vol. xv. part 1, October, contains.—Dr. C. Creighton, on an infective form of tuberculosis in man, identical with bovine tuberculosis, plates 1 to 6.—Dr. W. Allen, on a third occipital condyle in the human subject, plate 7.—Dr. J. Dreschfeld, some points in the histology of cirrhosis of the liver, plate 8.—Dr. S. Moritz, a contribution to the pathological anatomy of lead paralysis, plate 9.—Dr. G. S. Middleton, vascular lesions in hydrophobia and in other diseases characterised by cerebral excitement, plate 10.—Dr. D. Macphail, an ether percolator, for use in physiological or pathological laboratories, plate 11.—Dr. D. Newman, the comparative value of chloroform and ethidene dichloride as anæsthetic agents.—Dr. R. Pinkerton, observations on the temperature of the healthy human body in various climates.—Dr. George Hoggan and Dr. F. Elizabeth Hoggan, the lymphatics of cartilage and of the perichondrium.—Dr. R. J. Anderson, a palatine branch from the middle meningeal artery.—J. F. Knott, muscular anomalies.

Journal of the Royal Microscopical Society, vol. iii. No. 5, October.—W. H. Gilbert, on the structure and function of the scale leaves of *Lathræa squamaria*.—Dr. H. F. Fripp (the late), on daylight illumination with the plane mirror, an appendix to Part I. of the "Theory of Illuminating Apparatus."—W. Webb, on an improved finder.—W. A. Rogers on Tolles' interior illuminator for opaque objects, with a note by R. B. Tolles.—The record of current researches relating to invertebrata, cryptogamia, microscopy, &c.

THE *American Naturalist*, November.—F. M. Endlich, the Island of Dominica.—J. D. Caton, the Sand-hill Crane.—W. K. Higley, on the microscopical crystals contained in plants (concluded).—J. M. Stillman, on the origin of lac (regards it as a secretion of *Coccus lacca*).—Edward L. Greene, botanising on the Colorado desert.—The Editor's table on the obligations of educational and charitable institutions.

Zeitschrift für wissenschaftliche Zoologie, Band 34, Heft 4, September, contains:—a very elaborate memoir by Dr. Ferdinand Sommer of Greifswald, on the anatomy of the liver-fluke, *Distomum hepaticum*, L., pp. 540-640, with six plates; also by Dr. H. Michels, an account of the nervous system of *Oryctes nasicornis* as it appears in the larval, pupal, and imago conditions of this beetle, pp. 641, 700, with four plates.

Revue Internationale des Sciences biologiques, October 15, contains.—M. Vulpian, a physiological study of poisons, fifth lecture, on curare.—M. Hanstein, protoplasm considered as the basis of animal and vegetable life; introduction.—M. Borodin, on the physiological characteristics of asparagine.—M. L. Portes, on the asparagine of the Amygdaleæ.—G. Thoulet, contributions to the study of the physical and chemical properties of microscopical minerals.

THE *Transactions of the Yorkshire Naturalists' Union*.—Three parts of the above have been issued to the subscribers. These contain reports on the birds of the district, pp. 1-48. On the land and freshwater mollusca, pp. 1-16. On the lepidoptera, pp. 1-80. Botany, pp. 1-51. These reports seem well and exhaustively worked out, and deserve every support from the naturalists of the Yorkshire district and others.

SOCIETIES AND ACADEMIES

LONDON

Mathematical Society, December 9.—Mr. Samuel Roberts, F.R.S., president, in the chair.—Mr. William Ralph Roberts and Mr. Ralph Augustus Roberts were elected Members.—The following communications were made:—Note sur la Dérivation des Déterminants, Prof. Teixeira (Coimbra, Portugal).—Solution of the equation $x^p - 1 = 0$, quinquisection, Prof. Cayley, F.R.S.—A general theorem in kinematics, Prof. Minchin.—On the solution of the inverse logical problem, Mr. W. B. Grove.—Motion of a viscous fluid, Mr. T. Craig.—On the electrical capacity of a conductor bounded by two spherical surfaces cutting at any angle, Mr. W. D. Niven.

Chemical Society, December 2.—Dr. Gilbert, vice-president, in the chair.—The following papers were read:—On the volumes of sodium and bromine at their boiling-points, by W. Ramsay.—On the volume of phosphorus at its boiling-point, by D. O. Masson and W. Ramsay. The authors have determined the atomic volume (the atomic volume = the specific volume × atomic weight) of the following elements in the free state: Bromine 27·135, sulphur 21·60, phosphorus 20·91, sodium 31·00. The authors discuss the formula of oxy-trichloride of phosphorus, and conclude that in that substance phosphorus is a pentad, and that the constitution of that substance is $O{=}P{\equiv}Cl_3$. The atomic volume of phosphorus in this compound is therefore 21·1.—On the specific volume of chloral, by Laura Maude Passavant. Great care was taken in purifying the chloral; the specific volume, determined according to the method of Thorpe, was found to be 107·37.—Note on the formation of carbon tetrabromide in the manufacture of bromine, by J. C. Hamilton. A quantity of a white crystalline substance was obtained as a residue, after distilling a quantity of commercial bromine, it melted at 90°, and contained 97 per cent. of bromine.—Researches on the relation between the molecular structure of carbon compounds and their absorption-spectra, by W. N. Hartley. Part i.—General conclusions as to the nature of actinic absorption exerted by various carbon compounds. Part ii.—Experiments which prove the diactinic character of substances constructed on an open chain of carbon compounds. Part iii.—The actinic absorption exerted by various closed chains of carbon atoms. Part iv.—The absorption spectra of condensed benzen nuclei. Part v.—The cause of absorption-bands in the spectra transmitted by benzene and its derivatives.

Geological Society, December 1.—Robert Etheridge, F.R.S., president, in the chair.—Wm. Heward Bell, Wm. Jackson, Peregrine Propert Lewes, William Libbey, jun., D.Sc., New Jersey, U.S.A.; David Morgan Llewellin, John Marshall, Cyril Parkinson, Cornelius McLeod Percy, Thos. John Robinson, Rev. Alfred Rose, Berby Thompson, and Stuart Crawford Wardell were elected Fellows of the Society.—The following communications were read:—On remains of a small lizard from the Neocomian rocks of the Island of Lesina, Dalmatia, preserved in the Geological Museum of the University of Vienna, by Prof. H. G. Seeley, F.R.S. The author proposed to name this lizard *Adriosaurus suessii*.—On the beds at Headon Hill and Colwell Bay in the Isle of Wight, by Messrs. H. Keeping and E. B. Tawney, M.A. The authors criticised the views put forward by Prof. Judd in his paper published in the *Q. J. G. S.* xxxvi. p. 13, and supported those established by the late E. Forbes and the publications of the Geological Survey. The authors reject Prof. Judd's term Brockenhurst series, and revert to the classification and nomenclature of the Geological Survey.

Zoological Society, November 30.—Dr. Edward Hamilton, vice-president, in the chair.—Mr. Alfred E. Craven, F.Z.S., read a paper on a collection of land and fresh-water shells from the Transvaal and Orange Free State in South Africa, with descriptions of nine new species.—A second paper by Mr. Alfred E. Craven contained the descriptions of three new species of land shells from Cape Colony and Natal.—Surgeon Francis Day, F.Z.S., communicated a paper by Prof. A. A. W. Hubrecht, which gave an account of a collection of reptiles and amphibians made by Dr. C. Duke in Beloochistan.—A communication was read from Mr. J. H. Gurney, F.Z.S., containing a description of the immature plumage of *Dryotriorchis spectabilis* (Schleg.), a very scarce raptorial bird from Gaboon, now living in the Society's collection.—A communication was read from Mr. Roland Trimen, F.Z.S., on an undescribed *Laniarius* obtained by Dr. B. F. Bradshaw on the Upper Limpopo, or Crocodile River, in Southern Africa, which he proposed to name *Laniarius atrocroceus*.—A communication was read from Dr. G. Hartlaub, F.M.Z.S., containing descriptions of five new birds that had been collected by Dr. Emin Bey in Central Africa. These were proposed to be called *Tricholais flavotorquata*, *Cisticola hypoxantha*, *Eminia lepida*, *Drymocichla incana*, and *Muscicapa*

infulata.—Mr. W. A. Forbes, F Z S., read a paper on the external characters and anatomy of the Red Ouakari Monkey (*Brachyurus rubicundus*), describing more particularly the liver and brain, and made remarks on the other species of that genus and their distribution.

Anthropological Institute, November 23 —Allen Thomson, M D., F R S., vice-president, in the chair —The election of W R. Huggard was announced —A paper by Dr. Paul Topinard, entitled observations upon the methods and processes of anthropometry, was read Anthropometry means the measurement of the entire human body with the view to determine the respective proportion of its parts —1. At different ages, in order to learn the law of relative growth of the parts 2 In the races, so as to distinguish them and establish their relations to each other 3 In all the conditions of surrounding circumstances, in order to find out their influence upon the variations ascertained The number of skeletons at disposal for this purpose being small, all our efforts should tend to make perfect the methods of operating upon the living, and to simplify them, so as to render them accessible to all, to travellers, officers of the navy, recruiting agents, schoolmasters, &c., hence the number of measurements should be reduced to those strictly necessary, and only those insisted on which are really useful and lead to the knowledge of one of the natural morphological divisions of the body Heights above the ground, breadths, some circumferences, and perhaps the facial angle—to these we ought to limit our demands. The dimensions to be obtained directly, or by the method of subtraction, relate to —1 The trunk 2. The head and the neck taken separately. 3 The lower limb as a whole. 4. The upper limb as a whole 5 Each of the segments of the limbs, the hand, the forearm, and the arm in the one case, the foot, the leg, and the thigh in the other 6 The intrinsic proportions of the head, of the trunk, of the foot, and of the hand. Three fundamental principles to be observed are, determination and marking the reference points *slowly*, taking the measurements quickly, and the possession of good instruments The choice of reference points is a matter of great importance, and the author explained his views upon this subject —A paper by Mr. C. Staniland Wake on the origin of the Malagasy was read.

Physical Society, November 27 —Prof. W G. Adams in the chair —New Member, H C Jones, F.C.S —Prof Graham Bell exhibited his photophone, and explained the apparatus employed by Mr Sumner Tainter and himself for transmitting sound by a beam of light. The form in use consists of a metal plate or mirror vibrated by the sound and reflecting a beam of light to a distance, where it is focussed on a selenium cell in circuit with a telephone and battery. The light undulates in sympathy with the vibrations of sound, and alters the resistance of the selenium in accordance with the vibrations, thereby reproducing the sound in the telephone The electric light used was too unsteady to give articulate speech, but by means of a rotating disk perforated round its rim with holes the light could be occulted in such a manner as to give an audible note in the telephone Different varieties of receivers were described, some of which have not yet been tried One of these consisted in varying the rotation of the plane of polarisation of the polarised beam. A plan for transmitting the beam consists in making the vibrating plate vary the supply of gas to a jet or manometric flame The farthest distance speech has been heard by a photophone is 800 feet, but theoretically it should operate better the greater the distance between the mirror and selenium. On interposing a sheet of hard rubber in the ray, the invisible rays passing through it conveyed the sounds in a lower degree, and sounds can be heard by replacing the selenium receiver by disks of different materials, such as hard rubber, metal, &c, and simply listening at them. All substances appear to possess the power of becoming sonorous under the influence of varying light. Hard rubber, antimony, zinc, give the best effects, paper, glass, carbon, the worst. Even tobacco-smoke in a glass test tube held in the beam emitted a note, as also did crystals of sulphate of copper. When hard rubber was simply made into the form of an ear-tube and held in the beam, the audible effect was also produced, and in fact when the beam was focussed in the ear itself, without any other appliance whatever, a distinct sound could be perceived.—Prof. Adams thanked Prof Bell in the name of the Society, and called on Mr. Shelford Bidwell, who exhibited a lecture photophone, in which the reflector for receiving the light was discarded and the beam focussed on the selenium by a lens. The two lenses used cost only 25*s.*, and the beam was sent fourteen feet. The selenium cell was made by spreading melted selenium over sheets of mica, and then crystallising it by heat. For mica Prof. Bell recommended microscopic glass. The resistance of the cell was 14,000 ohms in the dark, and 6500 in the light. Speech was distinctly transmitted by this apparatus. Mr. J. Spiller thought that since selenium probably alloyed with brass and the baser metals, it would be better to use gold and silver for the cells, but Prof Bell said that he preferred brass, since (perhaps for the reason that Mr. Spiller gave) it yielded the best results.—Dr. J H. Gladstone read a paper on the specific refraction and dispersion of isomeric bodies—an extension of his paper of last June. He concluded that the dispersion of a body containing carbon of the higher refraction is very much greater than that of a body containing carbon of the normal refraction 5, and that isomeric bodies which coincide in specific refraction coincide also in specific dispersion

Entomological Society, December 1.—Sir John Lubbock, F.R.S, president, in the chair —Mr. Pascoe exhibited a large series of *Arctcus histrio* from Peru, to show the extreme variability of the elytral markings in this species.—Mr. Billups exhibited four species of *Pezomachus* new to Britain, viz, *P Mulleri*, *P juvenilis*, *P intermedius*, *P incertus*, and also exhibited twenty species of Coleoptera found in a small parcel of corn refuse The president exhibited two specimens in alcohol of a species of *Phasmidæ* forwarded by a correspondent in St. Vincent. Mr Cansdale exhibited a specimen of *Tischeria ganacella*, a species of *Tinæina*, new to Britain, he also exhibited a remarkable variety of *Cidaria russata*.—Mr J. Scott communicated a paper on a collection of Hemiptera from Japan. —Mr. C O. Waterhouse read a paper entitled description of a new species of the anomalous genus *Polyctenes*, and exhibited a diagram illustrating the structure of this insect

Royal Asiatic Society, November 15.—Sir H C. Rawlinson, K C B, F R.S, president, in the chair —Sir W R. Robinson, K C S I., S S Thorburn, Capt R Gill, R E., and the Rev Marsham Argles, M A., were elected Resident Members, and the Bishop of Lahore, Lieut. H E. McCallum, R.E, S. W. Bushell, M.D, and Abd-er-rahman Moulvie Syed, barrister-at-law, Non-resident Members.—Prof Monier Williams, C I.E, read a paper on Indian theistic reformers, in which, after showing that Monotheism was not of recent growth in India, he traced the development of the modern Theistic churches there, from Rammohun Roy, who formulated a system which may be described as Unitarianism based on Brāhmanism, through his successor, Debendra Nāth, who improved on Rammohun Roy's work by founding the Adi Brāhma Samāj, to Keshub Chundar Sen, who threw off altogether both Brāhmanism and caste, and founded his new progressive Brāhma Samāj in 1866. In his present eclectic form of Theism, composed of Hinduism, Mahammedanism, and Christianity, he teaches the worship of God under the character of a Supreme Mother Some of his followers, offended with him, chiefly for marrying his daughter before she was fourteen to the Mahārāja of Kuch-Behar, have recently set up a new Theistic Church called the Sudhārana Brāhma Samāj, or Catholic Church of God. There are now more than 120 Theistic churches in different parts of India

Royal Microscopical Society, December 8 —Mr. J. Glaisher, F R S, in the chair —Eight new Fellows were elected —Mr Wallis exhibited a new rotating substage, Mr. Mayall his form of spiral diaphragm, and Tolles' mechanical stage of extra thinness, and Mr. Crisp Crouch's histological microscope, Parkes's demonstrating microscope, Holmes's compressorium, and Atwood's rubber-cell —A paper by Dr. Hudson was read, on a new *Œcistes* (*Janus*), and a new *Floscularia* (*trifolium*), found by Mr Hood of Dundee in Loch Lundie. The trochal disk of the former formed a link between that of *Melicerta* and *Œcistes*. The latter was remarkable in having only three lobes and being much larger than any Floscularia hitherto known.—Mr. Stewart explained some peculiar structural features of the Echinometridæ, illustrated by specimens and drawings

Institution of Civil Engineers, November 9.—Mr. W. H. Barlow, F.R S., president, in the chair.—The paper read was on machinery for steel-making by the Bessemer and the Siemens' processes, by Mr Benjamin Walker, M. Inst. C.E.

December 7 —Mr. W. H. Barlow, F.R.S., president, in the chair.—The paper read was on the different modes of erecting iron bridges, by Mr. Theophilus Seyrig, M. Inst. C.E., of Paris.

Royal Society of Literature, November 24.—Mr. Charles Clark, vice-president, in the chair.—Sir Hardinge Stanley Giffard, Mr. Ramchundra Ghose, Mr. Henry Allpass, Mr. Robert White Boyle, Capt. W. Deane Seymour, Dr Altschul, were elected members.—Mr. F. G. Fleay read a paper entitled the living key to English spelling reform now found in history and etymology. The object of Mr. Fleay's paper was to show that the objections to spelling reform are principally founded on an exaggerated estimate of the amount of change required. This exaggeration has been caused by the revolutionary proposals of the leading reformers, who neglected the history of our language and the etymological basis of its orthography in favour of philosophical completeness. Mr. Fleay, on the other hand, proposed a scheme which was developed in two forms, one perfectly phonetic for educational purposes, the other differing from this only in dropping the use of the accents and the one new type required in the former. He showed that even in the vowel sounds not one-tenth would need alteration, while in the case of the consonants the alteration required would of course be much less.

Photographic Society, November 9.—J. Glaisher, F.R.S., president, in the chair.—Major Waterhouse, Bengal Staff Corps, read a paper "On a new method of obtaining 'grain' in photo-engraving." The method alluded to was to squeeze into the gelatine relief, while wet, sand- or glass-paper, previously waxed to ensure removal. The contraction of the paper while drying would force the granular substance into the relief more strongly in the shadows than in the lights, and thus a discriminating grain would be produced.—Capt. Abney, R.E., F.R.S., read a paper, "Notes on the gelatine process." The point insisted upon was that gelatine emulsions if kept some time before being poured upon the plates, extra sensitiveness would be the result; another matter was, that "frilling" could be prevented by the same long keeping of the emulsion; also that with emulsions where silver iodide is used, a few drops of hyposulphite of soda would bring out more detail in the image.

CAMBRIDGE

Philosophical Society, November 8.—Prof. Newton, president, in the chair.—The following communications were made to the Society:—On a new arrangement for sensitive flames, by Lord Rayleigh. A jet of coal gas from a pin hole burner rises vertically in the interior of a cavity from which the air is excluded. It then passes into a brass tube a few inches long, and on reaching the top burns in the open. The front wall of the cavity is formed of a flexible membrane of tissue paper, through which external sounds can reach the burner. The principle is the same as that of Barry's flame described by Tyndall. In both cases the *unignited* part of the jet is the sensitive agent, and the flame is only an indicator. Barry's flame may be made very sensitive to sound, but it is open to the objection of liability to disturbance by the slightest draught. A few years since Mr. Ridout proposed to inclose the jet in a tube air-tight at the bottom, and to ignite it only on arrival at the top of this tube. In this case however external vibrations have very imperfect access to the sensitive part of the jet, and when they reach it they are of the wrong quality, having but little motion transverse to the direction of the jet. The arrangement now exhibited combines very satisfactorily sensitiveness to sound and insensitiveness to wind, and it requires no higher pressure than that of ordinary gas-pipes. If the extreme of sensitiveness be aimed at, the gas pressure must be adjusted until the jet is on the point of flaring without sound. The apparatus exhibited was made in Prof. Stuart's workshop. An adjustment for directing the jet exactly up the middle of the brass tube is found necessary, and some advantage is gained by contracting the tube somewhat at the place of ignition.—Lord Rayleigh, on an effect of vibrations upon a suspended disk. In the British Association experiment for determining the unit of electrical resistance, a magnet and mirror are inclosed in a wooden box, attached to the lower end of a tube through which the silk suspension fibre passes. Under these circumstances it is found that the slightest tap with the finger-nail upon the box deflects the mirror to an extraordinary degree. The disturbance appears to be due to aerial vibrations within the box, acting upon the mirror. We know that a flat body, like a mirror, tends to set itself across the direction of any steady current of the fluid in which it is immersed, and we may fairly suppose that an effect of the same character will follow from an alternating current. At the moment of the tap upon the box the air inside is made to move past the mirror, and probably executes several vibrations. While these vibrations last the mirror is subject to a twisting force tending to set it at right angles to the direction of the vibration. The whole action being over in a time very small compared with that of the free vibrations of the magnet and mirror, the observed effect is as if an impulse had been given to the suspended parts. The experiment shown is intended to illustrate this effect. A small disk of paper, about the size of a sixpence, is hung by a fine silk fibre across the mouth of a resonator of pitch 128. When a sound of this pitch is excited, there is a powerful rush of air in and out of the resonator, and the disk sets itself promptly across the passage. A fork of pitch 128 may be held near the resonator, but it is better to use a second resonator at a little distance, in order to avoid any possible disturbance due to the neighbourhood of the vibrating prongs.

PARIS

Academy of Sciences, November 29.—M. Edm. Becquerel in the chair.—MM. E. and J. Brongniart presented a work on the silicified fossil seeds of strata of Autun and Saint Etienne, to which their father had devoted the closing years of his life. These researches led, among other things, to observation of a pollinic chamber in some living as well as in fossil species of seeds.—Note relating to a memoir on vision of material colours in rotation, and velocities estimated in figures by means of the turning-plate apparatus of General Morin, for observation of the laws of motion, by M. Chevreul.—On the spontaneous oxidation of mercury and of metals, by M. Berthelot. He concludes from experiment that mercury, like iron, zinc, cadmium, lead, copper, and tin, undergoes, in contact with air, a superficial oxidation, very slight, indeed, and limited by the difficulty of renewal of the surfaces and the absence of contact resulting from commenced oxidation. This agrees with thermic data. The oxidation of mercury liberates per equivalent of fixed oxygen + 21.1 cal (iron 31.9, tin 34.9, &c.). Spontaneous oxidation is not appreciable in metals whose heat of oxidation is very small, *e.g.* silver (+ 3.5 cal.). The greater rapidity of the reaction where an agent intervenes, which is capable of combining (with liberation of heat) with the substance produced, *e.g.* an acid, is shown to be in agreement with thermic theory.—On the propagation of light, by M. Gouy. He examines the case in which the rays have a constant direction, but vary in intensity, the source undergoing variations or being eclipsed by a moving screen. There is not, for a given homogeneous source, a determinate velocity of light, independent of the manner in which the amplitude is varied. But in every realisable experiment this variation is effected in a gradual and very slow manner relatively to the vibratory period; here the formulæ are simplified and the amplitude is transported as in a non-dispersive medium (with a velocity which is indicated by formula). The index of refraction is connected with the velocity of light by a relation easy to establish.—On linear differential equations with periodic coefficients, by M. Floquet.—On a new electric property of selenium, and on the existence of tribolectric currents properly so-called, by M. Blondlot. To one pole of a capillary electrometer a piece of annealed selenium is attached with a platinum wire; to the other pole a platinum plate. If the selenium be brought (with an insulating handle) into contact with the platinum the electrometer remains at zero; but on rubbing the selenium against the platinum a strong deflection occurs (often equal to that produced by a sulphate of copper element). The thermo electric current got by heating the selenium-platinum contact has an opposite direction to that of the current in question (which is from the unrubbed to the rubbed part of the selenium); thus the effect cannot be attributed to heat. On ceasing to rub, the deflection persists; the selenium, which let pass the high-tension electricity due to friction, opposing too great resistance for the weak polarisation of the mercury. Shock and even pressure produce the same effect as friction, though in less degree.—Action of phosphorus on hydriodic and hydrobromic acids, by M. Damoiseau.—On Waldivine, by M. Tanret. This is the active principle of the fruit of *Simaba waldivia*, which grows in Columbia. The composition of the crystals is represented by $C_{36}H_{24}O_{20}5HO$. The physical and chemical properties are described.—Direct analysis of peat; its chemical constitution, by M. Guignet. This relates to peat of very modern formation in the Somme Valley, formed under water in presence of carbonate of lime. Treated with water it yields *crenic* and *apocrenic* acid, also a little sulphate of lime. Alcohol at 90° produces a clear green solution, from which vegetable wax is got in abundance (the green matter has all the characters of chlorophyll). The

presence of *glucosides* can also be proved. Part at least of the total nitrogen of the peat (amounting to 3 per cent.) enters into the composition of the brown matters.—On the geology of the Northern Sahara, by M. Roche. *Inter alia*, he found in the middle of the Great Erg, south of Ouargla, a broad plane region about 250 km. long, covered only with isolated parallel dunes lying along the magnetic meridian; an important feature for the Trans-Saharan railway. All the strata of the Northern Sahara are nearly horizontal.—On some phenomena of optics and vision, by M. Trève. Looking at a lamp-flame through a fine slit in a disk, the brightness and the diffraction effects vary much, according as the slit is vertical or horizontal.—M. Maumené in a note attributes the difference of experimenters as to absorption of oxygen by mercury to more or less silver contained by the mercury.—M. Dubalen announced the discovery of a prehistoric grotto in the Department of Landes.

December 6.—M. Edm. Becquerel in the chair.—The following papers were read:—On the development of any function of the radius-vector in elliptic motion, by M. Tisserand.—Spectral reaction of chlorine and bromine, by M. Lecoq de Boisbaudran. For detecting minute traces he fuses on the hooked lower end of a platinum wire some pure carbonate of baryta; places in the bend a drop of the liquid to be examined; then evaporates, heating momentarily to a nascent red (with partial fusion); another platinum wire is then brought near the bend from below, and the induction spark gives a spectrum with lines of $BaCl_2$ or $BaBr_2$. The $\frac{1}{400}$ mgr. of chlorine or bromine may be thus detected.—M. Brioschi was elected correspondent in geometry in room of the late M. Borchardt.—On the action of water in applications of sulphide of carbon to phylloxerised vines, by M. Catta. He shows the injurious action of excessive humidity. The sulphide need not be in the liquid state if the ground be quite saturated with water.—On the swarming of phylloxera in 1880, by M. de Lafitte. This has been small, almost nil in some parts. The phenomenon is probably periodic, with a two years' period.—On mildew, *Peronospora* of vines (*Peronospora viticola*, Berk. and Curt.), by M. Cornu. This mildew will soon (perhaps next year) have spread over all France; and it is still almost unknown in regions where it prevails. The grape is not directly attacked, but the plant is injured, often disastrously.—New process for destruction of kermes of fig (*Ceroplastes rusci*, Lin.), by M. Gennadius. The insects may be got rid of by making a number of incisions on the trunk and branches, causing the plant to lose a large quantity of latex.—Observations of comet *d* 1880 (Hartwig) at Paris Observatory, by M. Bigourdan.—On the same comet and on Swift's comet (*e* 1880), by MM. Schulhof and Bossert. He obtains for the former a revolution of 1280 years (uncertain); for the latter, 5½ years.—On the method employed by Aubuisson in 1810 for measurement of geodetic bases, by M. Laussedat. This is, in substance, the same as the method now recommended exclusively by the International Geodetic Commission.—On the calculation of heights by means of barometric observations, by M. Angot. He cites some figures as showing the precision of his new method.—On the distribution of temperatures in the lower strata of the atmosphere, by M. André. From observations on the north and south slopes of Mont Verdun (625 m. in height) he infers that in the same vertical the distribution of temperature up to a certain height is absolutely indeterminate, thin hot- and cold-air currents being superposed on one another. The mode of superposition is in direct relation to the centres of high and low pressures.—On radiophony, by M. Mercadier. This name he gives to the phenomenon lately discovered by Prof. Bell. He shows reason for thinking it is not an effect of the mass of the receiving plate vibrating as a whole. Also the nature of the molecules of the receiver and their mode of aggregation do not seem to have a predominant *rôle* in the nature of the sounds produced. These sounds (he thinks) are due principally to direct action of calorific radiations on the surface of the receiver. (He got the maximum effect with invisible vibrations in the red and infra red.)—On the existence of perboric combinations, by M. Etard. Boric acid in presence of oxygenated water acts like a different acid, though of little stability: perboric acid.—On cobaltamines, by M. Porumbaru.—Researches on the comparative anatomy of the nervous system in the different orders of the class of insects, by M. Brandt. He gives the results of his own observations on Coleoptera, Lepidoptera, Diptera, and Hemiptera.—On a new form of vesicular worm, with exogenous gemmation, by M. Villot. This is named *Urocystis prolifer*, is a parasite of *Glomeris limbatus*, and has the peculiarity of living in the same host in different degrees of development; in the vesicular state proper, in the visceral cavity; in the state of scolex, encysted in adipose tissue. Buds are successively formed (containing a scolex) and detached.—Habits of a fish of the family of Silures, the *Callichthys facratus*, Cuvier, by M. Carbonnier. Its mode of reproduction is peculiar.—New researches on saxifrages; applications of their products to the arts and to therapeutics; experiments on their cultivation, by MM. Garreau and Machelart. Attention is called to a new substance, *bergenin*, obtained from the stocks; in the free and crystalline state it is represented by $C_8H_4O_4$. It is a strong neuro-sthenic tonic (between quinine and salicine). The tannin and fecula also obtainable, further recommend the cultivation of saxifrages.—On a process of meat-preservation by means of dextrine, by M. Senre. Meat dried and preserved with dextrine has remained unaltered twenty months, exposed to air.—The meteors of November 14, 1880, observed at Moncalieri (Italy), by M. Denza. Four observers counted thirty-seven in three-quarters of an hour. More than a third belonged to the stream of the Leonides, and they were the most beautiful.

VIENNA

Imperial Academy of Sciences, December 9.—Dr. Fitzinger in the chair.—Researches on Liverworts; 6. Marchantieæ, by Herr Leitgeb.—On the watercourses of middle Europe, and the importance of regulation of the Danube, with special reference to the stretch between Theben and Gonyo (Hungary), by Herr Lanfianconi.—On the formation of germinal layers in the hen's egg, by Herr Koller.—On combinations of chloride of calcium with fatty acids, by Herr Lieber.

Imperial Institute of Geology, December 7.—Geological map of the environs of Gratz, by Herr Hornes.—On a new mineral, *schneebergite*, by Herr Brezina.—Tectonics of the dioritic eruptive rocks of Klausen (Tyrol), by Herr Teller.—Geological map of Gorlice, by Herr Trajnocha.—On Predazzo, &c., by Herr Reyer.

CONTENTS

THURSDAY, DECEMBER 23, 1880

THE FOGS OF LONDON

LAST week Mr. Scott Moncrieff described in our columns a method of all but entirely eliminating smoke from the atmosphere of London, and thus abolishing that most venerable of our institutions—Fog. And in a recent number Dr. Siemens showed how our existing grates could be made to give out a maximum of heat at a minimum of expense and an entire absence of smoke. It may therefore be of some interest to inquire briefly into the latest theories as to the causes and consequences of this hideous incubus which renders residence in London a terror to so many.

Fogs are supposed to form a constituent part of the climatology of the British Islands from which there is no escape, and in certain strictly local climatologies, such as that of London, where the aggregation of human beings is altogether unprecedented, they now and again acquire an extraordinary intensity and persistency, and are attended with consequences so disastrous and fatal as to press urgently on Parliament the necessity of legislation towards the mitigation of the evil.

In illustration of this, reference may be made to the influence on the mortality of London exercised by the fog which prevailed there from November, 1879, to February, 1880, which was so remarkable both for its denseness and protractedness, as to constitute it one of the most memorable fogs on record The question has been investigated by Dr. Arthur Mitchell, and the results recently published in the *Journal* of the Scottish Meteorological Society

The increase in the death-rate was truly enormous, as these figures, giving the whole mortality for each of the seven weeks ending February 21, show—1754, 1730, 1900, 2200, 3376, 2495, and 2016; in other words, several thousand persons fell victims to the disastrous fatality of this great fog. An examination of the figures in the Registrar-General's Reports shows that no approach to so large an increase in the death-rate showed itself in any of the other British large towns, and in none of these did fog of a noteworthy character occur Of all diseases, asthma was most directly influenced in its fatality by the fog; for as the density of the fog increased so did the deaths from asthma, and as the fog abated, relief came at once to the asthmatic, and the death-rate instantly fell Thus the mortality rose to 220 per cent above the average during the week of densest fog, but as the fog gave way the mortality fell to 40 per cent. below the average Bronchitis, pneumonia, pleurisy, and other lung diseases appeared also with an enormously increased fatality, the mortality from bronchitis rising during the week when the fog was at its worst to 331 per cent. above its average In the case of these diseases however the relief did not come instantaneously with the cessation of the fog, but injuries of a more permanent nature appear to have been sustained which kept the death-rate at a high figure for some time after the fog had finally disappeared. Whooping-cough exhibited these characteristics in even a still more pronounced manner. The pernicious effects of the fog lingered still longer in the system, so that while the death-rate rose during the worst week of the fog to 182 per cent. above the average, four weeks thereafter it had fallen no lower than 74 per cent above the normal mortality of whooping-cough. It is singular, and particularly to the medical profession profoundly interesting, that deaths from croup, diphtheria, and rheumatism did not show any distinct relation to the fog As regards the other diseases, the deaths from which are registered, they equally did not appear to show any steady connection with the fog's varying denseness and persistency.

This pernicious and deadly character of fog on persons suffering from these diseases is not due to fog as such, but to the noxious qualities imparted to it by our large towns. Dr. Angus Smith has shown that the air of Manchester during an extremely dense fog contained 20 85 per cent of oxygen, or one-tenth per cent less than the normal quantity. The pernicious character of fog however is to be traced not so much to this slight diminution of atmospheric oxygen as to the presence of positively deleterious substances.

The smoke which issues from our dwelling-houses contains, in addition to solid soot, also gaseous carbonic acid, sulphurous acid, carbon monoxide, sulphide of ammonia, and sometimes minute traces of arsenic Moreover the soot does not consist of particles of carbon only, but carbon saturated with tarry matters, sulphur and ammonia compounds, &c. Smoke from manufactories is usually more completely burned than that from dwelling-houses, and is therefore less deleterious In many cases however manufactories pour out into the air their own specific hurtful gases. Of these gases the more pernicious are mineral acids, especially sulphuric and hydrochloric acids, sulphuretted hydrogen, sulphur dioxide, and oxide of arsenic. Gases rising from decaying animal and vegetable matter in waste heaps and in faulty sewers also lend their aid in the contamination of the atmosphere of towns In the neighbourhood of various manufactories solid impurities crowd the air, resulting in a denseness of fog in these restricted localities with an accompanying suffering and fatality elsewhere unknown

In February last we drew attention (NATURE, vol xxi. p. 355) to the question of fogs and the general atmospheric conditions under which they are generated, when the importance in discussing the question of fogs of a careful study of the anticyclone and its accompaniments was adverted to Indeed it is in the highest degree probable that all our memorable great fogs are intimately connected with the anticyclone, being found towards their outskirts or rather in the debatable region between the cyclone and the anticyclone They arise from the diffusion of the vapour brought up by the cyclone outwards and through the colder and drier air of those parts of the anticyclone contiguous to it, where it is condensed into immense breadths of fog stretching several hundred miles in length.

The two features of the anticyclone to which more special attention is directed are these, (1) the calmness or comparative calmness of the air, and (2) the *slow downward general movement of the atmosphere over the region covered by the anticyclone*, and a general outward movement in all directions towards surrounding regions as we near its outskirts

Consider now this feature of the anticyclone in its

relation to the vast quantities of deleterious matters which are vomited into the atmosphere from the chimneys of London. The horizontal movement of the air is at a minimum, and thus altogether insufficient to sweep these noxious matters out into the surrounding country The impurities therefore ascend into the air over London, and when no longer buoyed up by the warmer air with which they began the ascent, they fall under the influence of the general downward movement of the atmosphere, and this downward movement is accelerated by the solid impurities becoming saturated with condensed aqueous vapour, coal-oil, and tarry substances. Hence the specially noxious fogs of large towns settle near the surface, are no more than a few fathoms in depth, and are at the maximum where chimneys are planted thickest, the situation low-lying and confined, and where consequently the horizontal circulation of the air is absolutely arrested

If we would then overcome, or in any way mitigate, the terribly fatal effects of our city fogs, it can be done in no other way than by Parliament interposing with a legislation which will not only effectually stop the emanation of deleterious exhalations from manufactories, but also compel the combustion of the smoke arising from ordinary fires in dwelling-houses As regards the latter, where the real difficulty in legislating lies, it may be stated that we already have appliances for thoroughly burning coal, the use of which would be attended with an immense saving of money to the community, as well as the prevention of the painful recurrence of periods of such widespread sickness and mortality as London passed through in the beginning of the present year But it is of little use in science showing how this terrible evil may be cured if the authorities make no attempt to put her hardly obtained results into practice, it would cost little to give both Dr. Siemens's and Mr Moncrieff's methods a fair trial on something more than a miniature scale But what are some of the obstacles to such a practical course may be seen from our correspondence columns to-day.

WHAT IS CIVILISATION?

The Past in the Present. What is Civilisation? By Arthur Mitchell, M D, LL D 8vo pp xvi and 354. (Edinburgh David Douglas, 1880)

THIS interesting volume, as may be inferred from the title, embraces two cognate but at the same time somewhat diverse subjects—the one the survival, or possibly the reintroduction, of objects and customs, which are usually regarded as primitive, among the civilised nations of the present day, the other the nature and origin of civilisation

As Rhind Lecturer on Archæology Dr Arthur Mitchell selected these two subjects as the topics on which to enlarge, and devoted six of his lectures to the first and four to the second, and these lectures, illustrated by nearly 150 excellent illustrations, form the body of his book, to which is added a long appendix and a detailed analytical table of contents.

The facts brought forward in the first portion of the work, though for the greater part by no means new to most archæologists, are of considerable general interest, and will appear sufficiently striking to the ordinary reader. The peregrinations of the author in the remoter districts of Scotland and the neighbouring groups of islands have brought him in frequent contact with those among whom ancient customs are most likely to have survived, whose domestic appliances are often of the same simple character as were those of their ancestors generations and generations ago, and whose ordinary life has also been but little affected by the advance in material civilisation of their fellow-countrymen. To these objects and customs so persistently surviving from the Past into the Present the term "neo-archaic" has been applied by Prof Rolleston, and it is precisely these objects that a practised archæologist declines to regard as ancient, unless the circumstances of their finding justify him in so doing Foremost among them is placed the whorl and spindle, an appliance for spinning still in use in parts of Scotland, as it is throughout the whole of the continent of Europe, and which indeed is never likely to be entirely supplanted by the spinning-wheel or other machinery, so long as the use of the spindle can be combined with an out-of-doors occupation, such as tending sheep or cows All will agree with Dr Mitchell that the mental power of those Scotch women who still use the spindle and whorl need not be a whit inferior to that of those who do not use it, and some will go farther, and place the shepherdess who spins in a higher rank than the one whose hands are idle all the day-long That a spindle should be made of a form to do without a whorl, or that a potato should be substituted for the latter, are regarded by the author as signs of the art of spinning by hand having reached a state of degradation, but if producing the greatest effect with the least possible trouble is any sign of progress, such an opinion is questionable.

In all such cases the external circumstances of a family or group of families must be taken into consideration, and if it be cheaper or more easy to employ articles of the simplest and rudest character than to purchase, it may be from a distance, the appliances of modern art, the simple methods and appliances will survive. Netting and knitting by hand will thrive by the side of netting and knitting by machinery, as the long hours of a winter's evening, which might otherwise be wasted, can thus be utilised at practically no cost; and it seems more remarkable that the simple form of narrow loom for webbing, of which Dr Mitchell gives a figure, should have become almost extinct, than that it should have survived.

A flint for striking a light may be cheaper and in some respects more convenient than lucifers, and the "knockin'-stane" and mallet are not less effective for their purpose than the most expensive pestle and mortar. The earthenware "craggans" are as cheap and as well adapted for the ends they serve as pots thrown on the wheel, and in countries where carriage is difficult or extensive water power scarce, the quern or hand-mill and the little Norse-mill may still hold their own; as they did in St Alban's in the fourteenth century, when they competed with the high charges for multure at the Abbey mills. The survival of the black houses and beehive houses in the Hebrides may also probably be reduced to a question of cost. Perforated or grooved stones are cheaper than plummets of lead as sinkers for nets and lines; and for working in water a pivot and socket of

stone is probably both cheaper and more durable than one of metal The existence of sockets and other working parts formed of stone in our best clocks and watches can hardly be regarded as an instance of low civilisation, or of those who use them being in the Stone Age

In all these remarks Dr Mitchell will perhaps agree, and if the object of his lectures were merely to inculcate caution in accepting such objects as those he describes as belonging of necessity to any remote antiquity or to an absolutely rude and barbarous people, most archæologists would fully endorse his views But there is throughout these lectures a more or less evident intention that they should apply not to any minor questions of archæological classification, but to the far greater question of the progress of the human race. Though accepting the ordinary division of antiquities into those of the Stone Age, of the Bronze Age, and of the Iron Age, he does not regard the use of stone, bronze, or iron as in any way indicative of the culture and capacity of those who used them No doubt many of those who use iron and steel are mentally barbarians, and certainly the instances the author brings forward of the superstitious beliefs still prevalent in Scotland show how deeply rooted are such relics of early beliefs, and how little material civilisation has done to elevate the mental culture of the mass of the population. The distinction Dr Mitchell draws between culture and civilisation is one which is well illustrated by the continued existence of such low forms of belief, and all his readers will agree with him that it is an error to suppose that in this or any other civilised country the mass of the people can be spoken of as highly cultured. Civilisation he defines to be nothing more than a complicated outcome of a war waged with Nature by man in society to prevent her from putting into execution in his case her law of Natural Selection

Such a view of mankind being to a certain extent exempt from the operation of that law has already been held by many, but even if accepted does not appear to contradict the opinion that the human race may have been evolved from some lower form of mammalian life For on such an assumption it is, as Dr Mitchell insists, impossible that man in isolation could become civilised, while, on the other hand, it is evident that until he had become sufficiently intelligent or cultured to enter into association with his fellow men, he would remain subject to the law of Natural Selection in the same manner as any members of the brute creation. Nor even when the stage of association was reached can we expect that there should have been at once any great development of mental power, for there is a long interval between the banding together of a certain number of human units, and any one of them being in that position of ease and leisure which is so necessary for mental culture.

It is perfectly true that so far as osteological evidence is concerned there appears to be no tangible difference between the earliest known remains of man and the human frame of the present day. But it is by no means certain that all the skulls which have been attributed to the Quaternary Period actually belong to so remote an antiquity; and it is worth while to remember that among the coolies of China and some of the Pelew islanders, while the weight of the brain is singularly great, it is balanced by a marked deficiency in the number and depth of the secondary convolutions and by a want of depth in the grey matter

Dr Mitchell's view, though we believe nowhere clearly expressed, appears to be that during the whole period of the existence of the human race there was in some part of the world a state of civilisation in existence, which would imply that those among whom it prevailed were possessed of the same average mental capacity as any people or nation of the present day "May it not happen," he says, "that dealing with the human race as a whole, there never has been a time in its history when there did not occur among men states both of high and of low civilisation? Is it not also possible that there may have never existed a time in the history of mankind as a whole when there were not among those composing it persons potentially as good—persons exhibiting as high a capacity—as any among those who now go to make up mankind?" Were the history of our race confined to the last five or six thousand years it might be hard to answer these questions otherwise than in the affirmative, but who that appreciates the vast antiquity of man as established by recent geological discoveries will admit that such a term forms more than a small fractional portion of the period of man's existence upon the earth, or that there is any parity of reasoning between the circumstances of the beginning of the human period and of the comparatively recent times of Egyptian or Assyrian civilisation?

Granted even that the potential mental capacity existed, of what use could it have been to those who were daily on the brink of starvation, who were unacquainted with writing, and with metal, and had not even succeeded in domesticating any of those animals which now seem almost necessary for human existence?

This however is not the place to enter into a long discussion as to the origin and progress of civilisation. Those, and they are many, who are interested in this subject will do well to read Dr Mitchell's book, and even should they not agree with all his conclusions, will feel that his cause has not suffered from the treatment it has received at his hands.

They will also find in his Appendix much valuable matter extracted from the writings of Mr. Alfred R Wallace, Mr. Herbert Spencer, and Mr Bancroft To the antiquary pure and simple the illustrations of the "neo-archaic" objects still in use in Scotland will be attractive and valuable, and should some stray politician take up the volume some of the reflections on the dangers to civilisation which may arise from over-legislation, as set forth in the last of the lectures, may profitably be studied

AUSTRIAN MYRIOPODS

Die Myriopoden der österreichisch-ungarischen Monarchie. Von Dr. Robert Latzel. Erste Hälfte Die Chilopoden 8vo. pp xv and 228, plates i-x. (Wien Alfred Holder, 1880.)

THE centipedes, millipeds, and their allies have hitherto not only been neglected by English naturalists, but practically by Continental workers, until the present generation. Our countryman, Newport, indeed (of whom it may be said with justice, that he touched nothing that he did not elucidate and adorn), has secured a permanent

place in the annals of the class referred to; but it is to the brothers Koch, Meinert, and the Italians Fanzago and Fedrizzi, with the Bohemian naturalist Rosický, and some few other writers of less importance, that we have had to look in recent times for anything approaching serious or continued work upon these creatures. In America, Wood and A. S. Packard, jun., have also done good service. The writer of the book now under notice (Professor of Natural Sciences in the Imperial Franz-Joseph Gymnasium at Vienna) has by this sterling treatise at once assumed a place in the front rank of authorities We are not aware of any prior writings of his on the subject, beyond one or two of trifling local interest; but, from his five years' study and collection of material in various parts of Austria and in Western Hungary, it is clear that he is qualified for the task of monographing the species of his country, especially as he has examined nearly all the exponents in Austrian collections and museums. As he says, no work on the *Myriopoda* of Europe, or even of Germany and the Austro-Hungarian Empire, exists; so it is to be hoped that the present instalment towards such a desideratum may be from time to time succeeded by others of more extended area.

As regards the preparation, &c, of specimens, Dr Latzel recommends the use of small well-corked glass tubes, containing spirits of wine. Pinned examples are of no use.

Adopting the *Myriopoda* as a separate class (Packard seems alone nowadays in uniting them with the *Insecta*), the following classification is proposed Orders I CHILOPODA, II. SYMPHYLA, Ryder (for the *Scolopendrellidæ*); III. DIPLOPODA, with sub-orders *Chilognatha*, *Colobognatha* (for the *Polyzoniidæ*), and *Heterognatha* (for the *Pauropodidæ*); IV. MALACOPODA (*Peripatidæ*).

The present part discusses the *Chilopoda* only, the flat centipedes, with large sternum, and whose first pair of thoracic feet is transformed into foot-jaws. The common thin yellow *Geophilus*, which sometimes gives out a phosphoric light, is a type of the order Thirty-one genera are recognised, whereof fifteen are European, one American (*Notiphilides*), and one European (*Stigmatogaster*) being described as new, and *Opisthemega*, Wood, renamed *Megopisthus*. Sixty-seven Austrian species are described (*Lithobius*, the largest, with thirty-seven), including many new ones.

It is not within our scope to analyse the specific characters of such a work; Dr. Latzel seems to have performed his task conscientiously and exhaustively, giving the varied stages of development in each case where known ("juvenis," "adolescens," "pullus," and "fetus"), and combining biological and anatomical aspects with the purely descriptive accounts.

The *Myriopoda* have always afforded material for the comparative anatomist, as evidenced quite recently by MacLeod's researches upon the poison-bearing glands of various Chilopods (in the *Bulletin* of the Belgian Academy of Sciences, 2nd series, vol xlv. p 781 *et seq.*), and Voges's scheme for the classification of *Tracheata* (in Siebold and Kolliker's *Zeitschrift fur wissenschaftliche Zoologie*, vol. xxxi. p. 143), &c. Dr. Latzel recognises the importance of this element, and gives some remarkably well-executed lithographs (from his own designs) of such organs as are of general morphological importance, in addition to details illustrative of specific structure. Were it not for the general excellence of Continental work in such matters, we should congratulate Messrs. Hölder upon the result of their part in this matter.

OUR BOOK SHELF

Die Ethnographisch-Anthropologische Abtheilung des Museum Godeffroy in Hamburg. Ein Beitrag zur Kunde der Südsee-Völker Von J. D. E. Schmeltz und Dr med R. Krause. (Hamburg · L. Friederichsen and Co. 1881.)

THIS catalogue of the anthropological section of the Museum Godeffroy in Hamburg is a model of its kind, and from the exhaustive manner in which it is treated the publishers are quite justified in calling the publication as they do in their prospectus a "Handbook of Ethnography and Ethnology of the South Sea Tribes." The Godeffroy collection is probably unique and unrivalled as representing the area to which it is confined, and is another example of what private munificence can accomplish for scientific ends; and though the great merchant house may no longer have their collectors scattered throughout the South Seas, the town of Hamburg now possesses by their exertions the anthropological material which this somewhat bulky volume of 687 pages with 46 plates is found not too large to enumerate. However, this catalogue is not merely an enumeration, but contains much valuable geographical information, and some most useful bibliographical notes, which, in the present absence of any anthropological record compiled in the method and way of our zoological work, is, if not perfect, much to be commended, and not too critically received. The arrangement is geographical, and therefore ethnological in its true sense, as followed in most large museums, the Pitt-Rivers collection being of course a brilliant exception, which is rather designed to exhibit evolution in culture

The first part, "Ethnographische Abtheilung," is written by Dr. Schmeltz, and naturally occupies the largest portion of the volume. Australia is treated first, and then "Oceanien," commencing at New Guinea and terminating with the Sandwich Isles, including not only so large and well known an area as New Zealand, but also amongst others the smaller and much less known Exchequer Isles and Futuna. Of the last-named we are told incidentally that the fauna and flora is allied to that of Samoa. The Gilbert, Marshall, and Caroline Islands are then dealt with, the last very fully. This ethnographical portion concludes with Alaska and a few other various localities, thus showing that in the most special of museums the usual few outside elements obtrude

The second part, "Anthropologische Abtheilung," is the joint production of Messrs. Schmeltz and Krause, the first author treating the photographs and original drawings, whilst Dr. Krause enumerates and describes the osteological specimens. The cranial measurements are most desired by physical anthropologists, and it is to be hoped that some of our own provincial museums which are still behind in that respect, though possibly containing but few crania, will yet, where such can be authentically localised, have the same at once properly measured, and for a method, the lately-published Catalogue by Prof. Flower will supply all that anthropological science requires. Such Catalogues as the one under notice, taken with those of Prof. Flower and General Pitt-Rivers, are in themselves real manuals of anthropology.

W. L. D.

On the Digestive Ferments and on the Preparation and Use of Artificially Digested Food. By Wm. Roberts, M.D., F.R.S. (London: Smith, Elder, and Co., 1880.)

THIS little volume contains the three Lumleian Lectures delivered before the College of Physicians, London, for the present year. The subject is treated in a manner worthy of the reputation of the author. He gives a summary of what is known on the subject of digestion as a function common to animals and plants, treats of the general characters and properties of the digestive juices and their ferments, with an account of the action of each on food material. After many trials the author adopts three solutions for the preservation of his solution of animal ferment, full details of the preparation of which are given. The researches of Musculus and O'Sullivan as to the transformation of starch are given, with the very recent researches on the same subject by Brown and Heron. The subject of the digestion of starch is excellently handled, and any dyspeptic reader would do well to consider the facts and reasonings here so well and clearly given. The second lecture chiefly relates to pepsin and the digestion of proteids; digestive proteolysis; the milk-curdling ferment. The third lecture is devoted to the effects of cooking on food, preparation of artificially-digested food, peptonised materials, the clinical experience of the use of peptonised food, and on the use of pancreatic extract as an addition to food shortly before food is taken. These lectures, though at times technical, may be understood by the ordinary reader, who would often derive advantage from a general knowledge of their contents. As long as man must live on food so long will the proper digestion of that food be of extreme importance to him.

The Niger and the Benueh. Travels in Central Africa. By Adolphe Burdo. From the French by Mrs. George Sturge. (London: Bentley, 1880.)

THERE is a good deal that is interesting in M. Burdo's lively story of his voyage up the Niger and Benueh, partly in the company of Bishop Crowther. He gives many details of the various towns and villages he visited on the banks of the two rivers, and of the appearance and habits of the people he met with, all welcome information in a region on which our information is even yet comparatively meagre. M. Burdo's journey was made in 1878.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Smokeless London

I HAVE read the letter of Mr. Scott Moncrieff in NATURE, vol. xxiii. p. 151, with much interest, and am satisfied that his data and conclusions are substantially accurate. This conviction is based on some experience in the commercial distillation of coal.

One difficulty will arise which should at once be foreseen and provided against, or it may be exaggerated into a big bugbear by that class of self-styled "practical" men who oppose to every innovation the inertia of their own self-sufficient stupidity. The semi-coke remaining in the retorts, when only one third of the volatile constituents of the coal has been run off, will be highly inflammable, and display this property by a great outburst of lurid flame and dense smoke when the retort doors are opened for discharging, and unless the withdrawn charge is immediately quenched there will be a veritable Inferno where it falls. This is merely a matter of practical detail admitting of easy remedy where there is ability and willingness to grapple with it.

A more serious difficulty is likely to arise in London from the peculiar position of the gas companies. They are suffering from commercial congestion due to a plethora of prosperity, and receiving no stimulation from wholesome competition, they display very low commercial vitality. The public welfare is no business of theirs.

It is otherwise in those towns that are sufficiently advanced in civilisation and have abolished the gas and water joint-stock monopolies. There the public are helping themselves, and control the management of the Corporation gas works by their election of the members of the Corporation. Many of these towns are foggy and smoky enough for the experiment, and in these such a boon as that offered by Mr. Moncrieff will probably be appreciated, and, being appreciated by those most interested, will be at once practically tested. Birmingham, for instance, is likely to try it. I was there a few weeks ago and saw how they have eclipsed our electric lamps on the Embankment by the gas lamps around their town-hall.

If it succeeds in any one of these towns our companies will surely follow, or if not, so much the worse for the companies.

Stonebridge Park, Willesden, W. MATTIEU WILLIAMS
December 17

I HAVE read with great interest Mr. Scott Moncrieff's scheme for "Smokeless London" propounded in your last issue. I would ask however—Is he satisfied that the coke would be smokeless when only 3333 feet of gas per ton has been extracted from the coal? E. R. F.

London, December 20

Climates of Vancouver Island and Bournemouth

I THINK it very probable that your correspondent Capt. Verney is right about the climate of Vancouver's Island. My only sources of information were maps of isothermals in Keith Johnston's and Phillips' Atlases, which show the *mean* temperature about the same as that of the south of England, while the *winter* temperature is shown as being decidedly colder, and it was to this I more especially referred. The mainland of British Columbia is undoubtedly colder than that of Western Europe, but Vancouver's Island itself and the adjacent sea may be really milder, and if so it is another proof of the great power of the returning Japan current.

I shall be very glad of Prof. Haughton's criticisms on my hypothesis, and in the mean time will only say: 1. That unless Bournemouth is *never* cooled by north and north-east winds, any amelioration of the climate of the Polar regions would certainly benefit it. 2. That as by my hypothesis the entrance of two new gulf streams into the Arctic Ocean would entirely prevent the formation of ice, the return currents that would undoubtedly be produced would *not be cold currents* in the sense in which they are now, as they would probably be always considerably above the freezing point. ALFRED R. WALLACE

Geological Climates

IN relation to the discussion as to the importance to be ascribed to the distribution of certain trees and plants in the determination of geological climates, it may interest Prof. Haughton and Mr. Duncan to know that a specimen of the Australian *Araucaria Cunninghami* is now growing on one of the slopes of the Marlstone Hills near Belvoir Castle, in North Leicestershire, a position it has occupied for upwards of forty years. It has attained a height of about thirty five feet. Having survived (without other protection than that afforded by the wooded heights about it) the cold of the winters of 1860 and 1879, its capability to withstand a greater degree of cold than is ever experienced in our southern counties may be with confidence asserted.

Masses of a true and very characteristic bamboo, *Bambusa metaké*, are now growing vigorously and spreading rapidly on the same estate, the long elegant and slender canes and the delicate green foliage of this variety of bamboo not having suffered in the slightest degree from the severe frost of last winter or the early and equally trying severity of this. *Arundinaria falcata*, the bamboo found as high as the snow-line in the Himalayas, has also proved hardy at Belvoir, but it has been displaced as an ornamental plant by *B. metaké*. *Arundo donax*

often throws up clustering bunches of canes that reach a height of sixteen feet in one season. Associated with *Arundo conspicua* and *Gynecium argentum*, the above interesting and handsome plants give quite a tropical aspect to some of the hill-sides of this northern county. WILLIAM INGRAM

Belvoir, December 20

The Appulse of Jupiter to a Fixed Star on November 20

REFERRING to a request appearing in NATURE, vol xxiii p. 158, I may say that the approach of Jupiter to B D + 2°97 was well observed here, and I found that the star, when perpendicular to the belts, was 4″ 05 distant from the northern limb. The definition was good, and the measure, I should say, pretty exact

It was a strange and beautiful sight, Jupiter appearing with *five* satellites, though, at the same time, the different aspect of the star compared with that of the moons was very striking The light of the former was however very sensibly affected by the glow of the great disk near it, and it looked no more than 10 magnitude JOHN BIRMINGHAM

Millbrook, Tuam

British Earthquakes

MAY I ask leave to offer a few remarks on the leading article on British Earthquakes which appeared in NATURE, vol xxiii, p. 117. The author brings out very strongly the apparent connection between great lines of jointing or faulting and earthquake movements, and points out the great fault which traverses Scotland from sea to sea as a case in point Now I had this same question before the British Association this year, and exhibited a map illustrative thereof I had further, following up a theory submitted by me to the Royal Irish Academy, on the Correlation of Coast-Line Directions, and published by that body, drawn up on a Geikie's Geological Map of Scotland certain of those correlated lines, and on a smaller map of the British Isles had indicated both the lines in question and the localities wherein earthquakes have been noticed in later times, more essentially since 1860 One of those lines crosses the district about Comrie, and at the moment (August, 1880) could hardly be pointed out as in any notable way supporting the connection sought to be established between coast-line directions and earthquake localities. But the recent earthquakes in the north of Ireland and in Scotland go far to do this, as the direction shown by me both agrees with the great fault mentioned by the author of the paper on British Earthquakes in direction, and also fairly shows the direction of the earthquake band or zone, which apparently extends from Londonderry across Scotland This direction is exactly at 40° with the coast line direction between Carnsore Point and Wicklow Head, as shown on the accompanying map.

I may add that having had occasion to examine Prof Hofer's memoir on the "Erdbeben Karntens und deren Stosslinien," and to compare his lines with those given on the map of Europe exhibited by me at the British Association meeting of this year, I find some very remarkable concordances as regards directions, which, having submitted to him, he quite recognised. I consider therefore that this memoir, Prof. Geikie's very remarkable article on the Volcanoes of North-Western Europe, and this late article on British Earthquakes, all point more and more distinctly to the importance of jointing and fissuring in connection with volcanic and earthquake action, and so far go in support of the theory submitted by me. J P O'REILLY

Royal College of Sciences, Dublin, December 14

A General Theorem in Kinematics

I AM very much obliged to Prof. Everett and Mr. J. J Walker for having taken the trouble to point out that the theorem which I communicated to NATURE is, *so far as it relates to uniplanar motion*, already known. I am indebted to Prof. Unwin for more complete information on the subject He tells me that the theorem (for the uniplanar case) has been employed by German engineers in the discussion of stresses produced in moving pieces —exactly the use of the theorem which naturally presents itself. Moreover, the theorem (for the uniplanar case) will be found in § 198 of Collignon's "Cinématique," as well as in other foreign books, but not, so far as my information goes, in the work of any English author. None of your correspondents or of mine are however able to say that the *general* case was previously known.

The simple method of proof given by Prof. Everett is that which I had used nearly a month ago in a paper which I wrote (and have since read) for the London Mathematical Society.

I may mention in connection with this subject a kinematical theorem which Mr Kempe communicated to NATURE some time back. I find that this theorem comes properly under a general theorem which holds for the areas of roulettes It can be easily proved that the areas of the most general kinds of roulettes follow exactly the law of circular transformation which Steiner proved to hold good for the areas of pedals. For this theorem of Steiner's see Williamson's "Integral Calculus," p. 202, third ed.

Mr. Kempe's theorem (as also Holditch's) is an immediate consequence, since every possible uniplanar displacement of a body can be produced by epicycloidal motion. Mr. Williamson, justly describing Mr. Kempe's as "a singularly elegant theorem" (*ibid* p. 210), arrives at it quite differently.

GEORGE M. MINCHIN

Royal Engineering College, Cooper's Hill, December 13

A Correction

IN NATURE, vol. xxiii p. 44, Prof. Young has published some experiments proving that the thermo-electric power of a platinum-iron couple is to be observed in vacuo as well as in air, this fact is said to be contradictory to the results given in my papers I presume that some error has caused this statement, as I never and nowhere asserted that the thermo-electric power is dependent on the surrounding gases. I have, on the contrary, stated (*Phil Mag.*, October 1880, p 294) that no such influence has been hitherto observed Thus the experiments of Prof. Young do in no way contradict my views.

University of Vienna FRANZ EXNER

Jelly Fish

ON November 3, in the B.I S N. Co 's steamer *Arcot*, Capt Stevenson, while in lat. 16° 50′ N, long 55° 45′ E, with the Kuriyan-muriyan islands to the north, thirty to forty miles and three days out from Aden to Karachi, we passed through a vast quantity of brown anemones, the ordinary bell shaped jelly-fish and strange worm-like (apparently) jelly-fish, floating on and just below the surface. These were first noticed about five in the afternoon, and we were still amongst them when we went below to dinner at six, the vessel steaming about eight knots The anemones were only peculiar in that they appeared to be rounded at the base and without the ordinary flat surface for adhering to rock or stone; they were in vast numbers and had the feelers expanded The worm like or centipede-like jelly-fish were from six to eight feet long and as thick as a man's wrist. They appeared sometimes singly, sometimes many twisted together, they were in slow feeble snake-like motion All agreed that they were ribbed in appearance; but there was a difference of opinion as to the colour It was described by some as that of the sea, by others as violet, brown, or purple. Each apparent rib was divided from those next it by a bar of lighter colour.

At night the sea was bright with many phosphoric lights of many shapes, so we were perhaps still passing through the mass. There was a dead calm at the time

The captain has read this account and stated it to be fairly correct F. C. CONSTABLE

Karachi, Sind, November 8

MR. PLIMSOLL'S CURE FOR COLLIERY EXPLOSIONS

LET us suppose a person actuated by very powerful motives, who desires to solve the most difficult mathematical problem of the day, and who, after having neglected to acquire the most rudimentary knowledge of his subject, and after having contented himself with seeking the company of land surveyors, and trying to entrap civil engineers into conversations about it, suddenly startles the world with the cry of Eureka! Eureka! Eureka! should we, or should we not, be inclined to regard his solution with respect?

Mr. Plimsoll has done for the mining world exactly what our suppositious person would have accomplished for the mathematical one. In an article contained in the December

number of the *Nineteenth Century*, under the title of "Explosions in Collieries and their Cure," he lays before the readers of that magazine an account of the praiseworthy motives which impelled him to seek some means of preventing these horrible disasters, he tells them plainly that he knows little or nothing about the subject, and he recounts what steps he took for the purpose of supplying the want of that knowledge to some extent He says — "In my hope that the resources of chemistry might supply a solution of the problem which has so long perplexed everybody, I have made it my business from time to time to seek the society of practical chemists as well as of purely scientific men whose business it is to teach chemistry I have seen several amongst the former who are engaged in calico-printing works, lead-works, &c, and have sought, by getting them to talk about chemistry, and by so to speak lying in wait myself for some hint in their conversation, for something which might supply the missing link"

Mr Plimsoll then gives an account of how he travelled over the painfully disappointing road of trying to "unmask" the fire-damp, to "make it visible to the eye like smoke or steam," and to indicate its presence by means of a collodion balloon filled with the light carburetted hydrogen and put into a vertical recess glazed in front where it "would float upon the stratum of common air because filled with the lighter gas, but would remain at the bottom of the stratum of gas because kept down by the weight of the envelope inclosing it."

He says of the fire-damp indicator —"A delicate instrument has been invented, constructed on the principle of the diffusion of gases, but as this would require the application and careful observation of anybody using it, and as all it shows can be equally ascertained by watching the elongation of the flame on the safety-lamp, I pass it by."

He next asks, "Can this gas be absorbed?" and gives an example of what he means by describing the strong affinity which quicklime has "for hydrogen in the form of water", and lastly, he puts the question. "Supposing all these branches of inquiry to result unsatisfactorily, whether this gas should be loaded or neutralised in some manner that should render it non-explosive?"

We will pass over the incentives which our author brings forward with the view of stimulating men of science to undertake the work of discovery That these incentives are strong enough in all conscience we who heard the dreadful sound of the explosion at the Naval Steam-Coal (Penygraig) Collieries as we lay awake shortly after midnight on Friday last can testify from experience. A few hours later we breathed the fatal after-damp in a sufficiently diluted form to produce only headache and nausea: we looked upon the blackened remains of the victims as they lay or knelt on the ground, some having been hurled from a distance and having nearly every bone in their bodies broken, others having their coats tightly drawn over their necks and mouths and their faces buried in the dust, and still others actually kneeling, having their knees drawn more or less closely up under them, their hands pressed on their mouths and their faces also in the dust We saw nine fine horses that had been struck down where they stood in their stable never to rise again; one that had started off at a mad gallop, and been arrested in six yards by a fall of roof due to the blast which startled him, his legs and his whole body in an attitude of fierce action resting on the top of the fall, and his head laid gently on one side; two others lying on their backs with their legs in the air; another that had turned round in his shafts by some extraordinary convulsion, so that he faced the load he was drawing, while his body, with head erect, was twisted in between two props at the side of the road; and, lastly, a little donkey denuded of harness and tossed like a rag on to a heap of rubbish. We saw many of the bodies carried to the bottom of the shaft and sent to the surface, and others being carried from the pit to the homes where they lately dwelt, we heard the weeping of the bereaved ones; we saw one little knot of mourners from our very window, and since we began to write, as they gathered at the end of a row of houses, were joined by others bearing a coffin on their shoulders, and proceeded slowly down the road and out of sight, while the plaintive Welsh hymn that never fails to accompany such a procession rose and fell on the ear, and died away fitfully amongst the hills.

If any one can see and hear all this and more and remain unmoved, his natural affection is dead, and Mr Plimsoll's appeal will be made to him in vain Happily there are many whose hearts are wrung when they see or hear of the sufferings of their fellow-men, and who are always ready and willing to respond to such a cry

We will now turn to the second part of Mr Plimsoll's article, where we find his account of the manner in which he proposes to prevent "half, or it may happily prove even more than half, the number of explosions" He describes it in the following words —"I do not propose to alter anything in existing arrangements in the suggestion I am about to offer, but only to supplement them Let the present system of ventilation remain as it is in all its vigour, but in regard to the gas which escapes it, gets behind it, and accumulates in the upper and the waste portions of the pit, can we not go arm in arm with Nature in this matter, as we do in the others, and follow the gas whithersoever it goes and thus, in Lord Bacon's words, by obeying Nature learn how to conquer her?

"It goes to the highest part of the pit, therefore into the exhausted spaces I would work with this tendency, and, as in the case of water, a large hole is dug called a 'sump,' to collect the water at the bottom of the pit and so facilitate its removal by the pumps, so I would make a hole or sump for the accommodation of the gas; but as the water is heavy and lies upon the floor, and has the sump for it made in the floor, so my hole or 'sump' to gather the gas should be in the roof of the mine, and that in the highest accessible places.

"If it were certain that the water will run into the hole or sump dug for it in the floor or the lowest part of the pit, then it is equally certain that the light carburetted hydrogen would rise in the 'sump' or hole dug for it in the highest part of the workings of the pit

"I would then place a vertical tube with an open trumpet-shaped mouth, something like the funnel or chimney of a locomotive, in this place, and of such a length that the open mouth (which should be protected with a louvre covering or cap to keep out the dirt) should reach up very near to the roof; the bottom end of this pipe or tube I would continue to the bank of the pit; and as in the case of water you proceed to remove the accumulation by a water-pump, so in this case I would pump out the accumulation of light carburetted hydrogen by means of an air-pump; probably a small fan like that used in foundries would do as well, or even better

"This air-pump or fan could easily be worked by a strap from the winding-engine, or by hand It would require assistance during the daily drawing out of the pipe the atmospheric air which would fill it when the gas was exhausted from the mine. I ask your common sense, could you not as certainly in this way draw off every cubic foot of gas in the mine as you now can certainly remove the water from it?"

Mr. Plimsoll summarises in the following manner —

"1. Is it not a fact that the light carburetted hydrogen does and will seek the highest place of refuge open to it in the pit? 2. Is it not a fact that at this moment there is scarcely a coal-mine which has not gas in its goaves and highest parts? And 3 Is it not clear that by thus tapping the highest places it can as surely be drawn off as water can be pumped out of a pit?"

It would be impossible to controvert all the statements that Mr. Plimsoll makes regarding the properties of fire-damp, its tendency to rise to the highest point, and so on; he has supplied himself with all the knowledge necessary to understand its behaviour when it is found in easily manageable quantities. But what are we to think of his proposal when we come to deal with such quantities as 1000 and 2000 cubic feet per minute? Two hours after the explosion at the Naval Steam-Coal (Penygraig) Colliery we estimated the amount of fire-damp coming up the upcast at 1100 cubic feet per minute, and this is doubtless the normal quantity when the colliery is at work Dinas Colliery, which adjoins the last-named one, always produced about 1000 cubic feet per minute for some years before the explosion on January 13, 1879, Llwynypia Colliery, which adjoins the Naval Steam-Coal Colliery on the other side, produced 2000 cubic feet per minute for some years, but its output of coal is now less, and consequently its production of gas has decreased

But where does this gas come from, and how is it disposed of? In following one of the subdivisions of the air-current from the point where it leaves the main intake air-current to the point where it returns to the main return air-current we observe the following phenomena On reaching the first working place the air is still apparently as pure as it was when it left the surface; about the fifth or sixth place it begins to show the first symptoms of gas on the small flame of a glass safety-lamp (it is still invisible in a Davy lamp), at the tenth place the cap is quite apparent even to the unpractised eye, at the fifteenth place it is say $\frac{3}{16}$ of an inch in height, and at the twentieth place it is a $\frac{1}{4}$ of an inch. This is enough, and the current returns towards the upcast shaft without passing through any more places At the point of its junction with the main return air-current its cap remains exactly the same as it was when it left the last face We have ourselves verified these observations hundreds of times in different mines. The number of places through which the air must pass in order to obtain a given proportion of gas varies according to the rate at which gas is produced in the mine in question, and the volume of air passing along the faces.

In the most fiery mines we can generally follow the air-current from the surface, and return with it again to the surface after having passed along the working places without having seen the least accumulation of explosive gas. This is the rule; a cavity left by a fall of roof and containing explosive gas is the exception, and not only is no work allowed to be carried on near it, but means are taken to ventilate it as quickly as possible

How then could Mr Plimsoll's method be applied under these circumstances? Should we slacken the ventilation in order to give the gas time to rise to the roof, and after it got there to give it a chance of finding its way to a sump excavated for it somewhere or other? If so we should have streams of explosive gas travelling along the roof of the working places, and our dangers would be increased a thousandfold. We do not know what kind of mines those are in which Mr. Plimsoll has seen a stratum of explosive gas along the roof of the airways, but we should prefer not to have anything to do with them, even were his method applied for the purpose of drawing off the gas.

Let us take the explosion that has just occurred in the Rhondda Valley as an example. About ten months ago the two shafts, which are about 1111 yards apart, and over 400 yards deep, were connected together by an approximately straight heading, which is driven nearly level in coal from each shaft for say 520 yards, and descends the slope of a fault for 60 yards. The coal in one shaft is 30 yards below the level of that in the other shaft, and the surface of the ground at the top of the former shaft is 188 feet higher than at the latter. The fault forms a natural boundary between the workings of the two shafts, and, except for purposes of ventilation and communication, they were treated as distinct collieries. The workings are ranged on each side of the straight heading, there being four districts at the lower level (three on the right hand and one on the left, looking towards the higher shaft), and one district at the higher level (on the right hand side, looking in the same direction). The natural direction of the air-current is from the lower to the higher shaft The natural air-current gives a volume of about 30,000 cubic feet of air per minute at the present moment, and we are informed that when the fan was at work the volume was between 60 and 80,000 cubic feet The envelope of the fan was destroyed by the explosion, and the natural ventilation had to be depended on for the explorations so far as they have been carried.

Soon after midnight on the morning of Friday last there were somewhat over one hundred men and boys busily employed underground five were at the bottom of the upper shaft, four at the bottom of the lower shaft; seventeen or so were on the straight heading about half-way between the fault and the upper shaft, twenty-four were in the left-hand workings of the lower shaft; several gangs of from three to six were in each of the other three small districts of the lower workings; fifteen or so were in the right-hand workings constituting the only district in the upper pit; some were cutting coal, others were blasting down roof, some were filling rubbish, others were stowing it into empty places, and here and there a horse and his driver were proceeding along the roadways with short trains of full or empty waggons

No explosive accumulation of gas is said to have been found in the mine when it was examined a few hours previously, and two men, who came up only a few minutes before the explosion, had not heard of any unusual occurrence The mine is a very dry one, and there is abundance of very fine coal-dust to be found everywhere on the roadways.

A sudden shock was felt, a veritable hurricane swept through every passage and every open space communicating with the air-ways, a "darkness that might be felt" ensued for an instant, then a gleam of brilliant light accompanied by a shower of molten and red-hot dust, then darkness again, and all was still

During the interval between the raising of the dust and the passage of the flame some of the men, who evidently knew what had occurred, pulled their coats over their necks and mouths and staggered outwards, but fell after they had gone at most six or eight yards; others, as we have said, knelt down, covered their faces with their hands, and buried their mouths in the dust and small coal on the floor; the terrified horses made a few mad plunges, and then the Angel of Death breathed upon them all, and they remained transfixed in the positions they had assumed at that fatal moment. Only five men who were engaged in workings close to the downcast shaft escaped alive. They were rendered insensible by the after-damp, but recovered consciousness before the exploring parties reached them, having been revived by the fresh air which immediately flowed into the downcast shaft after the explosion was over.

We ask now where was the fire-damp accumulated that could produce so widespread an explosion, and at what part of the colliery would Mr. Plimsoll have placed his apparatus for the purpose of pumping it out?

The flame ramified into every district of workings both in the upper and lower pit, and left unmistakable tokens of its presence in the form of crusts of coked coal-dust on the timber, on the coal, and on some of the men's bodies.

It is evident that Mr. Plimsoll has remained unnecessarily ignorant that many men have been engaged in working out the problem he has attempted to solve. Let him go back to the many volumes of Parliamentary evi-

dence for information that will enable him to avoid all his useless work in trying to find means of "unmasking" or absorbing the gas; let him take up Faraday and Lyell's report on the Haswell Colliery explosion of 1844, and he will find his own proposal described in every essential detail, as well as a hint thrown out that coal-dust has much to do with explosions; let him peruse the copy of the report addressed to the United Committee of the Coal Trade by the Special Committee appointed to take into consideration Faraday and Lyell's report, and he will find the opinion expressed by the practical men of that day regarding the very plan he now brings forward as original.

But why should he labour through all that mass of reading and more than we have named, when he can find all that is of any value on the subject condensed in that most admirable dissertation, entitled "Rapport de M. Haton de la Goupillière (Ingenieur-en-chef des Mines, Professeur d'Exploitation des Mines à l'École des Mines), au nom de la Commission d'Étude des Moyens propre a prévenir les Explosions du grisou" (Paris Dunod, Editeur, Quai des Augustins, No. 49, 1880) In that volume he will find an account of all his own plans and those of many others, as well as much valuable information that will prove of inestimable value to him if he should decide to pursue this subject to its legitimate conclusion, as we most earnestly hope he will.

Mr. Plimsoll wrongs the scientific and mining sections of the community when he charges them with so much indifference. In England, in France, and in Belgium there is at present a Government Commission considering the subject of his article, viz. "Explosions in Collieries and their Cure," and collecting evidence which will be of great value in enabling us to approach nearer to the mark we are all aiming at

As usual the Royal Society travels in the van, and to our certain knowledge has given the sum of no less than 255*l.* within the last seven or eight years towards assisting in experiments which are being made with the view of throwing light upon the subject.

Similarly each of the Mining Institutes is eagerly canvassing every scrap of useful knowledge that may tend to lessen the risks of mining, and especially of explosions.

Lastly, in Germany we have also activity, and we can recommend a perusal of a pamphlet entitled "Die Verhuttung von Explosionen schlagender Wetter in Steinkohlenbergwerken," by Dr Adolf Gurlt, Bergingenieur, Bonn: Verlag von Max Cohen und Sohn (Fr Cohen), 1880 This pamphlet ends with the following words, in which it appeals to thoughtful miners We would extend the same appeal to one and all:—

"So mogen denn alle denkenden Bergmanner ihre Krafte vereinigen um dem verderblichen Feinde des Kohlenbergmannes, dem Grubengase, diesem Moloch, welcher noch fortwahrend so viele frische Menschenleben verschlingt, in Zukunft seine Opfer nach Möglichkeit zu entreissen."

If really safe safety-lamps were introduced that could not under any circumstances ignite an explosive mixture of fire-damp and air; and if at the same time the use of an explosive or other agent that produced no flame were substituted for that of gunpowder or dynamite, we might be comparatively free from explosions.

Thus far however neither the one nor the other of these desirable consummations has been attained.

On the other hand, if we could entirely eliminate explosive accumulations of fire-damp and air from our mines we should expect, according to the most generally received opinions, to be able to use naked lights and to fire shots wherever we had a mind to do so. Naked lights we might use under these circumstances; but we should protest in the strongest terms against blasting in the presence of dry coal-dust alone. The *rôle* of that agent has not yet been officially recognised, at least to the extent of framing special regulations to assist in dealing with it; and until it is so recognised we venture to assert that explosions will continue, and that the same impossibility of explaining them, save by the assumption of simultaneous eruptions of fire-damp in different parts of the workings, will continue to be experienced

That this is an illogical method of accounting for them may be gathered from the fact that the Risca explosion of July last required no less than three simultaneous eruptions to explain it The Penygraig explosion would require one in each district, but we say this without prejudice to the evidence either direct or circumstantial that may yet be forthcoming to prove the existence of explosive accumulations in one or more places in the workings.

In conclusion we would say that the Penygraig explosion cannot be explained by the fire-damp hypothesis alone, explosive accumulations may have been accidentally ignited by a shot, or by a defective safety-lamp, and so have originated the explosion, but something else than fire-damp, something whose presence was entirely ignored, took up the flame, carried it to the innermost and to the most extreme limits of the workings, and was in all probability the cause of 90 per cent or more of the deaths that ensued. Need we state our absolute conviction that that obscure agent was coal-dust?

W. GALLOWAY

COL. PRSHEVALSKYS' RECENT JOURNEY

THE new number of the *Isvestia* of the Russian Geographical Society contains the long-expected letters from Col Prshevalsky on his adventurous journey on the frontier of Tibet We have already referred to Col. Prshevalsky's work, the following further details will be of interest —His last news were dated from Hami, whence he proposed to go south-east to Tsaidam But it was impossible to find a guide a Chinese, given for this purpose by the Hami authorities, left the expedition some fifty miles from the town, after having led the travellers into a region full of great ravines M Prshevalsky, confident in his eleven companions, resolved to find his way himself by sending every day two men on horseback for distances of thirty and fifty miles round to discover the best direction. The advance was very slow, and the travellers spent one month and a half in the mountains south of Sa-djeou, discovering the high mountain-ranges to which they gave the names of Humboldt and Ritter. After a march of 190 miles they arrived at Kourlyk in the Tsaidam, but here also they were badly received, and could not find guides, owing to the secret influence of the Chinese. Finally M Prshevalsky told the chief of Kourlyk that he would take him as guide to Tibet if another guide could not be found, and on the following day the guide was found

On September 24 the travellers left Tsaidam Again the guide led them into impracticable tracts near to the Blue River, so that M. Prshevalsky's expedition was compelled again to seek its own way After having crossed the Blue River at its sources, they climbed the high plateau of Tan-la, after having crossed the 16,800 feet high pass across the border-range, which was covered with snow in October On the passage they were attacked by the nomad tribe of Egrays, but the companions of M Prshevalsky gave them a hot reception, and the Egrays fled, leaving four killed and several wounded.

Descending from the Tan-la ridge, the expedition continued its way to Lassa, but at the Nabchou settlement, 160 miles distant from the capital of the Dalai-Lama, they were met by Tibetians, who declared that the expedition could not be allowed to go further without a permission from the Lassa authorities, a thousand soldiers were assembled at Nabchou M. Prshevalsky gave his consent to await an answer from Lassa, and stayed at

Nabchou, buying food from the Tangoutes, who consider themselves as under the rule of the governor of Sining. Twenty days later the answer arrived; a messenger from the Dalai Lama, accompanied by seven officers, entreated M. Prshevalsky to return, saying that the whole population of Lassa was very excited against the strangers, as it was declared among the people that the expedition intended to steal the Dalai-Lama himself and extirpate the Buddhist religion. A conflict with the inhabitants of Lassa being most probable, M. Prshevalsky was compelled to return. All December and January were spent on the road to Tsaidam, the distance from Nabchou to Tsaidam being 560 miles. Progress on this high plateau (14,000 to 16,000 feet) was very difficult; out of thirty-four camels twenty died, and the collections were conveyed on horseback; the men mostly went on foot. We need scarcely say that the scientific collections and observations are of a great value.

On March 20 M. Prshevalsky reached the Chinese town of Sining, close to Lake Koko-noi. After having received permission from the governor of the province to go to the Hoang-ho, however, without crossing it, M. Prshevalsky sent his collections to Alashan, and went east to the banks of the Yellow River, which are fifty-six miles distant from the town of Donkyr. He reached them at the Gomi settlement. The river, 450 feet wide, and 8000 feet above the sea-level, is rapid (5 feet in a second). Its valley cuts deeply into a great deposit of clay, gravel, and boulders, the abrupt walls of which, along the banks of the main river, being 1600 feet high, and no less than 1000 feet along the banks of numberless tributaries. The journey across these gigantic ravines with abrupt walls (quite like those of the loess in the lower parts of the Hoang-ho) was most difficult. After a journey of 130 miles up the Hoang-ho, M. Prshevalsky reached a lofty mountain-range, which is cut through by the river, and probably is a continuation of the Burkhan-buda range. Further advance along the banks was impossible, and M. Prshevalsky not having a guide for crossing the range was compelled to return and soon reached the town Gui-domi, situated on the left bank of the Hoang-ho, forty miles below Gomi. The natural history collections from the Upper Hoang-ho are very rich: 260 species of plants, many fishes, and 500 birds. The astronomical and barometrical observations are numerous. M. Prshevalsky did not reach the sources of the Yellow River, and he supposes that they cannot be reached otherwise than along the Tibetan plateau; he doubts however that the Upper Hoang-ho makes so great a bend as it is usually shown on our maps.

The last letter from M. Prshevalsky is dated Gui-ta-din, on the Upper Hoang-ho. As is known, he returned *viâ* Alashan, and is expected at St. Petersburg by the end of January.

MICHEL CHASLES

THE news of the death of Michel Chasles, perhaps the oldest and best-known mathematician in Europe, will be everywhere learned with deep regret. For the fifty-five years over which his writings extend he has devoted himself with persistent industry to the history of geometry and to the perfection of those geometrical methods with which his name will be always associated. The "Aperçu historique sur l'Origine et le Développement des Méthodes en Géométrie," which in fact forms an elaborate history of the subject from the time of Thales and Pythagoras to the beginning of the present century, is the best known of his works; it was first published in 1837, and a second edition appeared only a few years ago. His restoration of the Porisms of Euclid was published in 1860. The last great work of Chasles related to the investigation of the number of conics satisfying any five conditions: the special method which he invented for these researches, termed by him geometrical substitution, involved the consideration of the characteristics of systems of conics, *i.e.* of the numbers of conics satisfying four common conditions and (1) passing through an assumed point, (2) touching an assumed line.

In 1865 Chasles received the Copley medal of the Royal Society; this medal has, since its foundation in 1731, been given only five times for discoveries in pure mathematics, viz., in 1784 to Waring, in 1814 to Ivory, in 1841 to Sturm, in 1865 to Chasles, and in the present year to Sylvester.

In 1846 Chasles was appointed to fill the new Chair of Modern Geometry, founded by the Faculty of Sciences at Paris; and as a professor he exerted personal influence over the younger geometers of that time, which has since been apparent in their writings, although the effect of the geometrical methods to which he devoted his life is chiefly visible in the works of the Italian and German mathematicians. He was the inventor of the term "anharmonic ratio," but not of course of the ratio itself, which was known to the ancients. Chasles's memoirs on the attraction of ellipsoids are well known to English mathematicians and physicists; and a translation of his memoirs on Cones of the Second Order, and Spherical Conics, was published in Dublin in 1841 by Dr. Graves, now Bishop of Limerick.

Most of our readers will remember how in 1866 Chasles was deceived by M. Vrain Lucas by what were called the Pascal forgeries, and they will also remember how honourably he extricated himself from the matter, and did all in his power to repair the mischief done. The forger was convicted and sentenced to two years' imprisonment; and not a shadow of suspicion was ever thrown upon the honour or good faith of Chasles.

Scientific visitors to Paris will miss a well-known face at the Academy and a kind and hospitable friend. Till quite recently Chasles seemed as active as ever, both mentally and physically, and it was only last September that he issued a new edition of his "Géométrie supérieure." He was a Foreign Member of the Royal Society and of the Cambridge Philosophical Society.

THOMAS RYMER JONES, F.R.S.

THE late Professor of Comparative Anatomy at King's College, London, whose death is announced, was born about the year 1820. He studied for the medical profession at Guy's Hospital, and took the diploma of the Royal College of Surgeons, London, in 1833. A chronic deafness unfitting him for the active pursuit of his profession, he devoted his attention exclusively to comparative anatomy. Some of his earliest papers were on the dissections of a tiger (*Proc.* Zool. Soc. 1834) and of an agouti (*Proc.* Zool. Soc. 1834). He was the first Professor of Comparative Anatomy at King's College, and was Fullerian Professor of Physiology to the Royal Institution in 1840. He was Assistant-Secretary to the Section of Zoology and Botany during the eighth meeting of the British Association held at Newcastle-upon-Tyne in 1838, the president of the section being Sir W. Jardine, the secretaries J. Edward Gray, Richard Owen, and John Richardson. This meeting was marked by the presence of Christian Gottfried Ehrenberg, who laid before the section a copy of his famous work, "Ueber Infusionsthierchen," making at the same time a short statement as to his views of the alimentary canal of the polygastric infusoria. These views were, in the discussion which followed, criticised by Rymer Jones, who stood almost alone among the British naturalists in opposing them. In 1838 the first part of his "General Outline of the Animal Kingdom" was published by Mr. Van Voorst, happily still among us. It was completed in ten or twelve parts, and was illustrated

by really beautiful woodcuts This work marked an era in the study of zoology and comparative anatomy in our country. True it is that the information of the author was mostly borrowed; true that he had no great familiarity with the work of the German naturalists of the time, true that the book will not bear to be appealed to now but forty years ago it was the best book of its sort in England, and the generation has not as yet quite passed away which learnt from its pages We have altered since then, both in the manner and the matter of our teaching of comparative anatomy, and for the better no doubt, but after another forty years our systems may too have seen their day It may be conjectured that this book was in advance of its day, for an eminent writer, in reviewing it in 1839, objected to Rymer Jones' facts about the Infusoria, and declared he still placed confidence in Ehrenberg's observations, while he criticised his description of *Volvox globator*, and believed this "Infusorian" had nutritive organs, mouth, eyes, &c.

Prof R. Jones was an extensive contributor to Todd's "Cyclopædia of Anatomy and Physiology," writing no less than twelve of the articles on comparative anatomy. He was the author of at least one work on popular natural history, called the "Aquarian Naturalist." He was an excellent lecturer, and though never rising to the highest rank as a biologist, well deserves this passing notice in our columns

FRANK BUCKLAND

FRANCIS TREVELYAN BUCKLAND was born on Dec 17, 1826 He was the eldest son of the Very Rev Dr. Buckland, Dean of Westminster. As a boy he was a constant companion of his father in the latter's geological excursions, he was a scholar of Winchester College and a student of Christ Church, graduating M A of Oxford in 1848 About this date he entered St. George's Hospital as a student of medicine, taking the diploma of the Royal College of Surgeons, London, in 1851, becoming house surgeon to St George's Hospital, and lastly receiving the appointment of assistant-surgeon to the 2nd Life Guards, a position he held until 1863 He seems to have been always well liked in his regiment, gaining the character of a pleasant, good-natured, sociable fellow Although fond of all that pertained to natural science, he was in no sense of the word a profound naturalist, he could seize with alacrity the popular side of a scientific question, but he seldom went deeper. Perhaps the most scientific work he ever accomplished was the editing, in 1858, of his father's work on "Geology and Mineralogy," published as one of the Bridgewater treatises. He was the author of some pleasant volumes entitled "Curiosities of Natural History," was a constant writer in *Land and Water*, and an occasional contributor on subjects of economic zoology to the daily press On the subjects of fish and fish-culture he was an authority, and it will be remembered that he had an interesting museum in connection with the subject at South Kensington. For his labours in this direction he received several honourable distinctions from France, and in 1869 he was appointed by the British Government one of the Inspectors of Salmon Fishing for England and Wales. He was also one of the Commissioners appointed to inquire into the Crab and Lobster Fisheries of this country, and the results of this Commission culminated in the useful Act regulating the oyster, crab, and lobster fisheries of the kingdom, which received the Royal assent in 1877.

One notable event of his life was the discovery he made in 1859 of John Hunter's coffin in the vaults of St. Martin's-in-the-Fields, which was re-interred at the expense of the Royal College of Surgeons in Westminster Abbey.

Familiarly known by a large circle of friends as Frank Buckland, he has left them while still in middl life, and it will be long ere they look upon the like of poor Frank again

NEW GUINEA[1]

II

THE various accounts of the natives given throughout these volumes leave an impression of vagueness that is very unsatisfactory The mixture of races in various parts of New Guinea is no doubt great, but we cannot help thinking that there is a well-marked Papuan type, and that its head-quarters are in this great island Signor D'Albertis seems to attach too much importance to minor peculiarities. He continually mentions small differences in the features, the hair, the form of the skull, or the stature, as implying a radical difference of race, forgetting that such differences are found among every people and in every country, and that on this principle we might establish a dozen different "races" in Europe. Taking the term Papuan in a broad sense as including all the dark-skinned woolly or crisp-haired tribes of the Western Pacific, it seems clear that New Guinea is very largely peopled by this race, and that its north-western peninsulas contain the most typical examples of it In the south-east however another race is found which may be described as yellow-skinned and smooth-haired, and these are clearly Polynesians or "Mahori," that is of the same race as the natives of Samoa and New Zealand In the Fly River and adjacent country both these occur, as well as a mixed race, which D'Albertis seems to think is destined to supplant them. He describes these races as follows —

"The two varieties to which I allude may be defined thus, the yellow, and the black. The term yellow does not exactly express the first, nor does black the second, and those adjectives must be used comparatively only. The characteristics of the yellow variety are as follows:—hair curling or smooth—neither crisp nor woolly, black and shining, often almost of a chestnut hue, forehead large and flat; temples little, if at all depressed; eye orbits scarcely, if at all, prominent; cheek-bones rather high; round chin and round face; large brown eyes, with eyeballs of a bluish-white, the nose often aquiline, never flattened, and generally small, lips moderately full, and brachycephalous and round skull. These people are not prognathous In colour they vary from brown to very light brownish yellow In stature they are not generally inferior to the black race, and their forms are fuller and rounder

"The black variety is distinguished by a narrow and retreating forehead, compressed temples, strongly-marked orbital arches, prominent cheek-bones, aquiline nose, pointed and narrow chin, long face, decidedly prognathous, an oblong skull The eyes are small, either black or brown, the eyeball bloodshot or yellowish, and the men are tall and generally thin The preponderating type exhibits every gradation that can result from these two varieties

"We may therefore conclude that the present inhabitants of Hall Bay (opposite Yule Island) are a mixture of two races, one dark-skinned and crisp-haired, the other with lighter skin and smooth hair, and this is all that can be said from our present knowledge"

The light race—which we may call Papuan Mahoris—are far more civilised than the dark Papuans. D'Albertis says of them:—

"The most perfect harmony seems to reign in families, and rare indeed are cases of quarrel among members of one household. They live in communities, sometimes of more than a thousand inhabitants, in well-built villages,

[1] "New Guinea What I Did and What I Saw" By L M D'Albertis, Officer of the Order of the Crown of Italy, &c, &c In two volumes (London Sampson Low, Marston, Searle and Rivington, 188c) Continued from p 155

worthy to be called small towns, both for their order and cleanliness. They are under the rule of the chiefs or land-owners. The chief is looked upon as father of the family He is called Pacao, and his servant or subject is called Irine. From all I could learn, slavery does not exist, and the sale of human beings is unknown" After describing their daily avocations, amusements, dress, implements, and ornaments (a group of which are figured), he goes on: "Their natural disposition is gentle and placid. They like to spend their time in talking and games, in which men and women take an equal share. Playful and free of speech, they nevertheless do not transgress the bounds of modesty, either in word or deed Women and children are included in every conversation, and often take part in public discussions, which are usually held in the evening. Women are always respected, and in some villages they enjoy a certain supremacy, although the government of the house belongs to the husband. Labour may be said to be fairly divided between the two sexes, and they are accustomed to work from their earliest childhood. . . . The material for civilisation is in them, but will the change make them better? Will they be the happier for

FIG 4—Durabi, a native of Kiwai Island, at the mouth of the Fly River

it? This is a difficult problem, and one which cannot be solved until the experiment has been made. For my part I do not doubt that these, more readily than any other savages whom I know, would answer to the call of a civilised nation which, stretching out a paternal hand, would lead them towards our civilisation! To insure success, however, they should be treated as friends, not as slaves, they should be cherished, not destroyed."

Unfortunately our attempts at civilising savages have as yet in every case failed Are we still, notwithstanding all our wretched failures, to go on in the old way, and allow these interesting and now happy people to be first ruined morally by the teaching of the dregs of our Australian and Pacific traders, and then physically deteriorated by the forced introduction of a form of civilisation utterly unsuited to them? Cannot either philanthropy, or religion, or Government protect these people from all such external influences as have been proved to be unsuited to their condition and stage of development, while aiding them to work out for themselves an indigenous civilisation? Here is perhaps the last chance we have to preserve one remnant of the better class of savages from being crushed under the Juggernaut car of our high-pressure civilisation and mad struggle for wealth.

The inhabitants of the lower part of the Fly River appear to be mostly dark Papuans, while further in the interior a mixed race was met with. Among the curious articles found in this part of the country were numbers of stone clubs, carved into various star-like shapes and forming terrific weapons in close combat. Stone axes are also largely used, closely resembling in form the neolithic celts of Europe.

Maino, chief of Moatta, a village at the mouth of the Fly, was a great friend of D'Albertis', and accompanied him on one of his voyages up the river. An elaborate study, both physical and mental, was made of this savage, and forms one of the best and most valuable passages in the book. A few extracts will show its character. After describing his person, our author goes on:—

"The above is a sketch of the animal Maino. I will now try to draw his portrait as a man, according to the moral sense of that definition. The opinion I have formed of him as a reasonable being is favourable. It is not however necessary to examine him very closely with European lenses, remembering that he is what we call a savage. He has sufficient intelligence for his position, and probably he is not capable of more. . . . He is friendly to the white man because he fears him, and because he knows he can gain by him. He is proud, and takes offence easily, without however showing that he is

FIG 5—Maino, Chief of Moatta

irritated; only once during two months and a half did he display any anger. He is generally silent, and seems meditative. Sometimes he is lively and will laugh, but his laugh appears studied and forced, not natural or spontaneous He is cruel rather from instinct than from education, and in a way that we Europeans can perhaps neither understand nor appreciate justly His cruelty raises him in his own estimation and in that of his dependents—in the eyes of his friends and of his enemies. He considers men and women, if they are strangers to him, good for nothing but to have their heads cut off. Up to the present time his victims number thirty-three. A warrior who bravely attacked him, or a woman sleeping in the forest would be to him exactly the same thing. He would see in each a trophy, a victory; and what he would esteem would be their skulls. He likes to see blood, and it is with marked satisfaction he describes the *modus operandi* in cutting off a head, the instruments used in the operation, and the method of surprising an enemy by treachery, even if a woman or a child. . . . He is tender and affectionate towards his own family, and to his sons at least his temper may be said to be mild. . . . Maino is remarkably selfish. He would willingly let others die of hunger if to relieve them he would have to sacrifice some delicacy intended for himself. I experienced this during the voyage. . . . Notwithstanding certain traits which might make him appear a bad man in the eyes of Euro-

peans, I can testify that Maino is a good fellow, and was a good comrade to us all. His rank and his age prevented his being useful except as a pilot, but in that capacity he was most valuable."

Turning to the lighter race, one of the most interesting and novel facts we find recorded of them is their most ingenious mode of cultivation. Fields were observed in Yule Island so well and evenly tilled that they appeared as if they had been ploughed, but it was afterwards ascertained that all had been done by manual labour.

"The natives form gangs of eight or ten men, each man holding in either hand a very hard wooden pole, sharpened to a point, over six feet long and from an inch to an inch and a half thick. These men stand in a row, and at a given signal plant their rods in the ground, repeating the operation several times until they have penetrated to the required depth, which is generally about a foot. This done, they bear down on the other end of the poles, making them act as levers, and thus loosen a long piece of ground, ten to thirteen yards long, and from a foot to a foot and a half wide; then by alternate heaving up and bearing down, the large mass of earth is upturned, and as they take care to preserve the same measurements and distances, regularity like that of the action of a plough is produced."

On his way home, fresh from New Guinea, Signor D'Albertis suffered partial shipwreck in the Red Sea, and met a number of Somauli men and their families, and was much struck by their resemblance to Papuans. He says: "Who will believe that in these people I seemed to be renewing my acquaintance with the natives of New Guinea, especially those of Torres Straits! Such is the impression they made upon me. I observed the true negro type, which differs from them in several respects, but if several of these natives were transported to New Guinea they might be mistaken for aborigines of that country; those with the receding forehead, aquiline nose, and moderately thick lips—who have curly but not woolly hair. They belong to the type I called Arab when speaking of Moatta and Tawan—the type which, although not predominating, I have often found in New Guinea, and I discover them to-day on the shores of Ras Afun." Our traveller had two true Jamaica negroes with him in New Guinea, and these also closely resembled other types of Papuans, although there were certain minute characteristics of skin and hair by which they could be distinguished. Taken as a whole, and speaking broadly, the Papuan and African races would appear to belong to the same great type of mankind.

FIG 6.—Attacked by Canoes on the Fly River

Our readers will now perceive that, as the journal of an enterprising and observant traveller, Signor D'Albertis' work is one of considerable merit. It is written in a simple unaffected style, and bears internal evidence of accuracy and absence of exaggeration, while it no less clearly shows that in all the best qualities of a traveller its writer has rarely been surpassed.

Living among some of the wildest of savages he overcame them by kindness, courage, and by exciting in them a dread of his vast powers of destruction and command over the forces of nature; and he never took away human life except when attacked by overwhelming forces—when the vessel committed to his charge as well as the lives of its crew were in imminent danger on the Fly River, and even then he beat back his enemies while doing them the smallest possible injury.

Turning now from the general character of the book and of its author, and considering it as an expensive and

somewhat pretentious work brought out by an English publisher, we feel bound to state that it is full of grave defects. This is due probably to the incompetence of the editor, or the total absence of any such necessary functionary; for the original was written in Italian, and we cannot believe that the author himself corrected or supervised the proofs In the first place a considerable number of the illustrations seem to be thrown in at random, and are not referred to at all in the text. Such are the portraits at pp 59, 140, and 151 in vol i. Ornaments and implements from the Fly River are figured in the first instead of in the second volume. A cut of thirty-four separate articles (at vol. i p. 416), though all numbered, has no reference to the numbers; while at vol. ii. p. 136, four elaborate spears or ornamental staves are descri.ed as "Baratus," which are said in the text to be "pieces of armour for war," and to be "worked in very hard stone"!

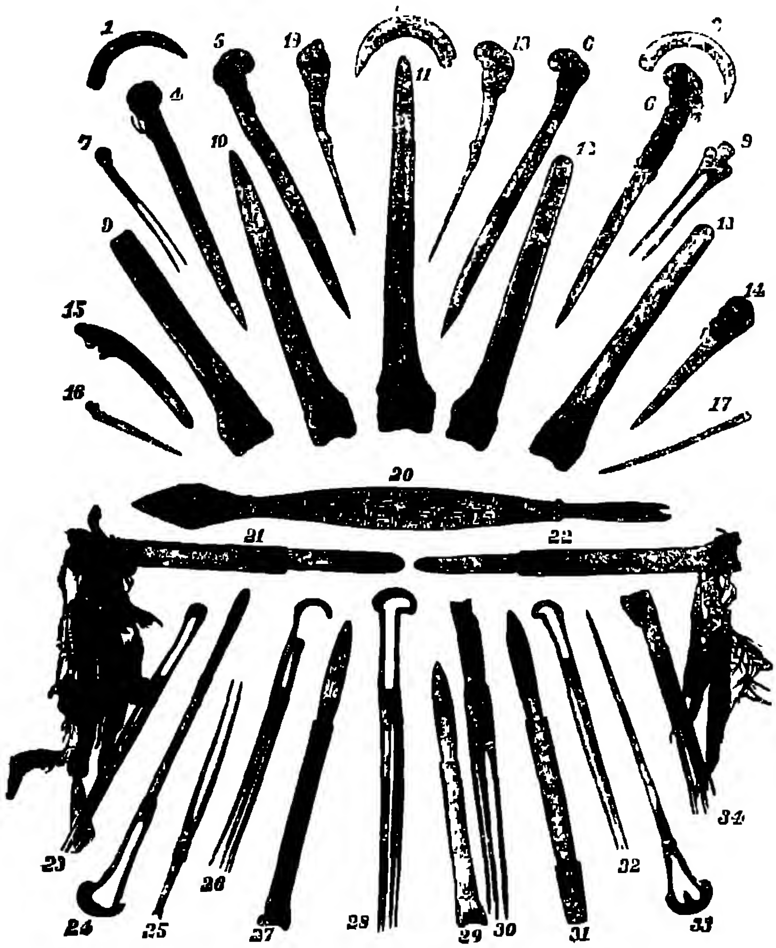


Fig 7.—Implements and Weapons From the Fly River (upper set) and Hall Sound (lower set)

The misprints and misspellings are excessively numerous. At p. 4 we read of "temples excavated in the deserted roads" in Java. At p. 49 the traveller goes to the "source of the river" instead of to its mouth, and at p 222 we have "stone nails" instead, probably, of stone clubs. The names of places and of plants and animals are rarely spelt correctly, and are often spelt differently in adjacent pages. The Italian mode of spelling scientific names has not been altered, and they are often almost unintelligible to an English reader, as *Oloturia* for *Holothuria*, *Stafilinus* for *Staphylinus*, and *Cicas* for *Cycas*. Orankaya (a village chief) is sometimes spelt Orankay and sometimes Oranhay. Waigiou is spelt Waigen, and immediately afterwards Waigeu. Battanta is spelt Battauta, and Daudai is spelt Dandai At the end of the book four vocabularies of native languages are given, but as if to make these of as little use as possible, they consist of four different sets of words, all differently arranged, and none in alphabetical order; so that any comparison with each other or with vocabularies given elsewhere is practically impossible without the preliminary labour of rearranging them Add to this that there is no index to the book and that the only map given is a poor and imperfect one, and it will be seen that the merits of Signor D'Albertis' work have not been enhanced by the manner in which it is presented to the reader

The illustrations on the whole are good, the coloured plate of birds of paradise being excellent But far too many skulls are figured, since these are of no possible interest to the general reader, while, as we have no guarantee for their accuracy, or that they are all figured on exactly the same scale, they will have little value for the man of science.

From the notices scattered through these volumes Signor D'Albertis appears to have made very large collections in natural history, especially of birds, reptiles, and insects It is to be hoped that complete series of these have been kept together, and that, in conjunction with those collected by Dr Beccari, they will be made the subject of some important works. The birds are being carefully elaborated by Prof. Salvadori, but the reptiles and the insects would probably throw even more light on the zoological relations and past history of this wonderful island

Alfred R Wallace

PHYSIOLOGY OF PLANTS

THE two papers [1] which we notice together under the above heading, though relating to different questions in the physiology of plants, have nevertheless something in common Both of them bear on the relationship between the external and internal conditions of life, between external forces, such as light and gravitation, and the constitution of the organism on which these forces act And both tend to show the importance of recognising in plants those specific forms of sensitiveness which may be said to determine the results which will follow external changes

I The behaviour of leaves in relation to light may be illustrated by the cotyledons of a seedling radish; if it is illuminated from above, the cotyledons are extended horizontally, and are thus at right angles to the direction of incident light. If the seedling is then placed at a window, so that it is lighted obliquely from above, and if the stem (hypocotyl) is prevented from bending, the cotyledons will accommodate themselves to the changed conditions by movements in a vertical plane. The cotyledon which points towards the light will sink, while the other will rise, and thus both will become once more at right angles to the incident light.

Two theories have been proposed to account for this

[1] I "The Power possessed by Leaves of placing themselves at right angles to the direction of Incident Light" II "The Theory of the Growth of Cuttings, illustrated by Observations on the Bramble, *Rubus fruticosus*" Read by Francis Darwin before the Linnean Society, December 16, 1880.

property of leaves. the first is that of Frank ("Die naturliche wagerechte Richtung von Pflanzentheilen," 1870), who ascribes to leaves and to some other organs a specific sensitiveness to light called "transversal-heliotropismus" or diaheliotropism ("Power of Movement in Plants," p 438). Just as an ordinary heliotropic organ has an inherent tendency to become parallel to incident light, so a diaheliotropic organ has an inherent tendency to place itself at right angles to the direction of the light The two classes of organs differ from each other exactly as some creeping rhizomes differ from ordinary stems; the rhizome tends to extend itself horizontally under ground, while the stem above the surface grows vertically upwards (see Elfving, in Sachs' "Arbeiten," 1879).

A different theory has been proposed by de Vries (Sachs' "Arbeiten," i 1872), whose views are supported by Sachs ("Arbeiten," ii 1879) with additions or modifications. According to these views it is not necessary to assume the existence of any special kind of heliotropism, since the phenomena might result from the ordinary forms of heliotropism and geotropism acting in concert Thus in the case of the seedling radish illuminated from above, if the cotyledons were apheliotropic (negatively heliotropic) and apogeotropic (negatively geotropic) it is possible that they might be kept in equilibrium by these opposing tendencies. The tendency to move away from a vertical light will make the cotyledons curving downwards towards the earth, and the apogeotropism or tendency to move away from the centre of the earth may exactly balance the downward tendency, so that the cotyledons remain horizontal

Besides the various geotropic and heliotropic tendencies there are other modes of growth which may enter into the combination In some cases there is a natural preponderance of longitudinal tension or growth along the upper surfaces of the petiole, so that owing to impulses arising within the plant there is a tendency for the leaf to curve downwards, or more accurately in the direction in which the morphologically lower side of the petiole is directed, this tendency is called longitudinal epinasty, or simply epinasty, the opposite tendency is called hyponasty. According to the theories of de Vries and Sachs epinasty may be opposed by heliotropism, or by apogeotropism, while hyponasty will of course be opposed by apheliotropism and geotropism, and all these opposing forces may combine in producing an equilibrium The object of the present paper is to test the relative values of the two above described theories that of Frank, and that of de Vries and Sachs.

The method employed was to fix the plants under observation to a horizontal spindle, which was kept in slow rotation by clockwork This instrument (called the klinostat) has been employed by Sachs for the study of ordinary heliotropism, light is admitted parallel to the axis of rotation, and the plants are thus subjected to a constant lateral illumination, while they are freed from the disturbing influence of gravitation, for, owing to their being kept in constant slow rotation, there is no reason why they should bend apogeotropically in one direction more than another (see Sachs in his "Arbeiten," Bd. ii 1879). On the same principle the behaviour of leaves which place themselves at right angles to the incident light has been studied. If a plant with horizontally-extended leaves, which has been illuminated from above, is fixed on a slowly-revolving, horizontal spindle, so that the axis of the plant is parallel both to the axis of rotation and to the direction of incident light, we shall have a means of testing the opposing theories above mentioned.

The plant's leaves will still be illuminated by light striking them at right angles; therefore if Frank's theory is the right one they ought to remain in this position. But if de Vries and Sachs are correct in their views, the leaves ought *not* to be able to remain at right angles to the incident-light, since apogeotropism has disappeared, which was one of the tendencies necessary to keep the leaves in a position of equilibrium.

A considerable number of experiments were made with the celandine, *Ranunculus ficaria*, the results of which are decidedly in favour of Frank's views. The leaves of the celandine are sometimes extremely epinastic, so that they press against the ground, and when a plant is dug up it often happens that, the leaves being released from the resistance of the soil, curve nearly vertically downwards. If such a plant is fixed on the klinostat in the position above described, the leaves will be pointing away from the light, so that if the leaves were apheliotropic, as might be expected according to de Vries' theory, the leaves would remain pointing away from the window But this is not the case, they move forwards until they are approximately at right angles to the light, and then come to rest. Again, if a celandine is placed in the dark its leaves rise up so as to be highly inclined above the horizon, if the plant is then placed on the klinostat the leaves (which now of course point towards the light) again accommodate themselves by curving backwards until they are at right angles to the light. Thus the leaves cannot be called heliotropic or apheliotropic, we are forced to believe that under the stimulus of light they are able to move in either direction, which may be necessary to bring them into the plane at right angles to the light. The other experiments with *R ficaria*, the details of which we omit, lead to the same general result.

Besides a few observations on Vicia, Cucurbita, and Plantago, a series of experiments were made on seedling-cherries, and these lead to a somewhat different result. A cherry-plant illuminated from above has its leaves approximately horizontal, and when placed on the klinostat, as above described, the leaves are unable to remain at right angles to the light, but curve backwards so as to become parallel to the stem of the plant. This movement can be shown to be due to epinasty, not to apheliotropism, and is the result of the loss of balance which follows when apogeotropism is removed. It is clear therefore that the horizontal position of the leaves of seedling-cherries growing normally must largely depend on the balance struck between epinasty and apogeotropism, in accordance with the views of de Vries and Sachs But since these forces obviously cannot produce the power which the cherry possesses, of altering the position of its leaves in accordance with the direction of the light, we must assume that some kind of heliotropism enters into the combination. The view to which the present research lends most probability is that dia-heliotropism (transverse-heliotropism) is the really important influence at work. In the case of the celandine we have seen that the sensitiveness to light is strong enough to determine the position of the leaves—although the natural balance is disturbed by the annihilation of apogeotropism. It seems probable that an essentially similar state of things holds good in the case of the cherry. When the plant is growing normally it trusts to epinasty and apogeotropism to produce an approximate balance, the final result being determined by the stimulus of light. But when the balance is disturbed by placing the plant on the klinostat, the light-stimulus is not strong enough to produce a condition of equilibrium

This view is the same as that given in "The Power of Movements in Plants," and is in accordance with the principle there given. that the chief movements in plants are due to modifications of the circumnutating motion.

II. When a cutting, for instance a piece of a willow-branch, is placed in circumstances favourable for growth, it produces roots at its lower end, while the buds at its upper end grow out into branches. The experiments of Vöchting ("Organbildung im Pflanzenreich," Bonn, 1878) on the growth of cuttings were made by suspending

pieces of stems, branches, &c, in large, darkened jars, the air in which was kept constantly moist by a lining of wet filter paper. The cuttings were suspended both in the normal position—that is with the upper end upwards—and also upside down Vochting found as a general result that there is a strong tendency for the roots to appear at the *basal* end,[1] and the branches to be developed at the *apical* end, whether the cutting had been hung apex upwards or downwards in the glass jar.

Vöchting believes that the growth of roots at the base and of branches at the apex of a cutting are determined chiefly by an innate, inherited, growth-tendency. When the knife divides a branch into two cuttings it separates a mass of identically-constituted cells into two sets, one which form part of the apex of the lower cutting, and another set which form part of the base of the upper cutting And under appropriate circumstances one of these sets of cells might develop into roots, the other into adventitious buds. Vocht holds that it is the morphological positions of these sets of cells (the fact of one being at the base and the other at the apex of a cutting) which chiefly determines the course of their subsequent development. The idea may be expressed somewhat familiarly by saying that each cutting into which a branch is divided is able to distinguish its base from its apex, and can tell where to produce roots and buds, by means of an internal impulse or morphological force which is independent[2] of the external forces, gravitation and light

The theory which Sachs has brought forward in his paper on "Stoff und Form der Pflanzenorgane" ("Arbeiten des bot. Inst Wurzburg," 1880, p. 452) is entirely opposed to that of Vochting. Sachs conceives that Vochting's morphological force is not an innate hereditary impulse, but a tendency produced by the action of external forces during the growth of the formative cells. Thus Sachs believes that the force of gravity acting on the developing cells of an organ produces in it a "predisposition" or enduring impulse which manifests itself in the results which Vochting ascribes to a hereditary force The mode in which Sachs believes gravitation to act is interesting, not only in itself but also as a modification of a theory of Du Hamel's It is assumed that difference of material is a necessary concomitant of difference of form, and that accordingly the materials from which roots are formed are chemically (used in a qualified sense) different from those which supply the branches Sachs' theory supposes that the growth of roots or buds at a given place will be determined by the distribution of the root- and branch-forming materials, and that the distribution of these materials is regulated by the force of gravity. The root-material is in a certain sense geotropic and flows downwards, the branch-material having the opposite tendency. But they are not supposed to be *simply* geotropic, the tendency of the root-material to flow towards the base of a branch is continued after the branch has been made into a cutting and hung upside down, so that the root-material flows upwards towards the base of the cutting, because that end was originally downwards, and *vice versâ* with regard to the branch-forming matter.

The observations on the bramble, which form the subject of the present paper, were carried out with the object of deciding how far the natural growth of roots in the bramble agrees with Vochting's or Sachs' theories on the growth of cuttings.

The long sterile shoots of the bramble are well known to possess the power of rooting at their ends. The terminal bud is thus protected during the winter, and the store of nutriment contained in the club-like thickened end of the branch forms a starting-point for new growth in the spring. It is commonly the long pendant branches growing vertically downwards which reach the ground and form roots It might therefore be supposed that gravitation determines the growth of roots at the *lower* end of the branch, just as in a cutting made from an erect willow branch the roots grow at what was originally the lower end But observations made on brambles under certain circumstances show that this is not the case When brambles grow on a steep bank the majority of the branches grow down hill at once, or else straggle more or less horizontally along the bank and finally turn downwards. But a certain number of branches grow uphill, and some of these take root at the apex. When therefore we find on the same individual plant some branches forming roots at the physically lower, and others at the upper end, we may feel sure that the distribution of root growth in the bramble is not determined by gravitation We mus believe that there is a morphologically directed impulse which tends to the production of roots at the apex of the branch, whether the direction of its growth has been upwards or downwards It is true that in the observed cases the extreme end of the branches was bent so that from 1 to 9 inches was inclined at from 2° or 3° to 5° below the horizon, but it can hardly be imagined that this fact influences the growth of roots at the apex; and experiment shows that it is not necessary that even a single inch should be inclined below the horizon. A bramble branch was tied, apex upwards, to a vertical stick, and was surrounded by damp moss and covered with waterproof cloth, under these circumstances a plentiful crop of roots sprang from the terminal part of the branch This result combined with the observations made with brambles growing on a steep bank seem to show that an internal impulse or morphological force regulates the growth of roots in the bramble.

When a cutting is made from a bramble the only development that takes place is the growth of the axillary buds at the apical end of the cutting. Under certain circumstances these side shoots take on a root-bearing function They are stunted in growth, being, it may be, 10-12 mm in length and 3 or 4 mm or more in breadth; they assume a peculiar club-like form, being thicker at the apex than at the base, and are clothed with rudimentary scale-like leaves, from among which a number of relatively large roots spring forth

In order to determine whether the production of this root-bearing type of root is determined by gravitation or by a "morphological force," cuttings were made from branches whose direction of growth was above the horizon. Such cuttings were hung apex upwards, and it was found that the most apical buds were capable of developing under these circumstances into the root-bearing type of branch Similar rooting side-shoots are produced by cuttings made from branches which have grown beneath the horizon, it is therefore clear that gravitation is not the chief[1] determining force in this form of root production

When the end of a branch is injured, which often occurs when a bramble grows along the ground near a pathway, the most apical bud or buds grow out into branches; these may be ordinary branches which ultimately take root. Under certain circumstances, the stunted club-shaped root-bearing side-shoots may be developed whose whole formation is devoted to the bearing of roots. It is therefore clear that the production of such rooting shoots in cuttings is the same process that occurs in branches injured in a state of nature; a process which enables the branch to perform the function, the normal performance of which had been interfered with. And this fact enables us to see in what way a

[1] The basal end is that end of a cutting nearest to the parent plant, the apical, is the opposite end

[2] Vöchting states distinctly that gravitation and light do affect the positions in which organs are developed in cuttings, but he considers the internal impulse as the stronger determining cause

[1] The experiments seem to show that gravitation has *some* influence on the growth of roots in the bramble

morphological growth-impulse is better fitted for the requirements of the case than any possible dependence on gravitation as a guiding force. When the end of a branch is injured it is clear that if a side-shoot is to be developed to carry on the function of the injured apex, it will have the best chance of success if it starts from the position which the end of the original branch had already gained before it was injured. Therefore the bud which is nearest to the injured apex will be the most suitable one to be developed into a new branch And thus it is advantageous to the plant that the place where the new development is to take place should be determined morphologically, not by gravitation

Thus in the bramble the behaviour of cuttings is a repetition (cf Vöchting, "Organbildung," p 107) of the normal process of restoration of a deranged function in the plant, how far this is the case with other plants must remain at present undetermined

NOTES

WE are very glad to hear that Bedford College is taking a leading part in giving to women the opportunity of studying thoroughly physical science It has this session opened a physical laboratory, under the able direction of Dr Lodge A chemical laboratory was added to the College some years ago, and has proved of great service to the students, several of whom have passed the science examination of the University of London.

THE death is announced of M Lécard, a promising French botanist, as the result of excessive fatigues during his late journey in Soudan. M Lécard was formerly director of the Public Botanical Gardens at Saigon, in Cochin-China, and at Richard Toll in the colony of Senegal During the past year he was intrusted by the French Minister of Public Instruction with the important mission of studying the flora of the Upper Niger, a question now of no slight interest in view of the probable construction of the Trans-Saharan Railway. Various difficulties prevented his reaching the Niger At Koundiam, however, the most distant point reached in his journey, where he was forced to pass the rainy season, he made the valuable discovery of five varieties of annual vines, the fruits of which so closely resemble our ordinary grapes that he regarded them as fully able to replace the grape in the production of raisins and wine. M. Lécard hoped also to find in his new discovery the means of satisfactorily combating the phylloxera, and inspired with this desire, sought to make extensive collections of the seeds of the vines to bring back to France M. Lécard, in a letter recently read by Dumas before the French Academy of Sciences, expressed the fear of having lost his health by the privations incident to this journey—a prevision unfortunately too completely realised.

THE death is reported of Dr. Wilhelm Heintz, Professor of Chemistry at Halle University, at the age of sixty three years.

THE death has taken place, on the 16th inst, at the age of ninety-one years, of Mdlle. de Montgolfier, daughter of Etienne de Montgolfier, the inventor of the balloon to which his name is attached.

PROF. WILLIAMSON, Graham's successor in the Chair of Chemistry at University College, London, has complied with the request of the committee of the Chemical Section of the Philosophical Society of Glasgow that he should act as adjudicator in the competition for the Graham Medal.

PROF. TYNDALL, Prof. Haeckel, and Dr. Andrew Buchanan have been elected Honorary Members of the Philosophical Society of Glasgow.

AMONG the buildings which are to be erected on the new Observatory grounds in Paris when legally handed over to Admiral Mouchez will be the great dome for the large refracting telescope which is now building This dome will measure twenty metres in diameter, and its weight will exceed sixty tons.

THE credit of 300,000 francs asked by M Cochéry for the forthcoming Exhibition of Electricity and Congress of Electricians at Paris has been voted by the Chamber of Deputies unanimously. The Bill has been sent to the Senate, which will probably have passed it by the time this number is published.

ON December 12 took place at the Sorbonne the celebration of the fiftieth anniversary of the foundation of the Polytechnic Association for delivering scientific lectures all over France. This Society was established a few months after the Revolution of July, 1830, by a certain number of pupils of this celebrated school. The principal address was given by M Gambetta, who praised science in magnificent style. M Gambetta declared his conviction that Auguste Comte was the profoundest thinker of the whole century

FREQUENT observations on the retrograde motion of glaciers have been made of late years. One of the most assiduous of observers is Herr W Gromer, proprietor of the Hotel on the Schafberg He reports that during September the retrograde motion was exceptionally large, larger indeed than he had ever seen during seventeen years. The Gosau glacier (Dachstein), the Hochalmspitze, and the Uebergossene Alp showed hardly any ice at all on September 12 last, so that with the telescope only *débris* of rocks could be seen. Herr Gromer ascribes this phenomenon to the unusually high temperature which reigned upon the Alps during last winter, as well as to the constant rain during the summer

WE are glad to receive a third edition of vol I. of Harcourt and Madan's "Exercises in Practical Chemistry" (the Clarendon Press). Mr. Madan is the sole reviser of this edition, and we quote with approval the following passage from his preface — "Practical chemistry seems in danger of being made far too much a study of a few reactions of salts, got up for the purpose of detecting them in the course of an analysis. This is of course due to the requirements of examiners, to satisfy which nearly all the very moderate time available for practical instruction in schools must at the present day be spent. Moreover analytical work (in the narrow, technical sense) entails, like Latin verses, less trouble to the teacher and less risk to the pupil than other kinds of practical work, while it undoubtedly affords, when intelligently used, a very excellent training in the application of logical methods But it may well be doubted whether a more real and valuable advance in a scientific education is not made by the careful preparation and examination of the properties of such a substance as oxygen, or by an exact study of a few examples of oxidation and reduction, than by simply observing, for instance, that chlorides give a white precipitate with silver nitrate which is soluble in ammonia."

MR. C SCHOESSTER, one of the Commissioners at the Melbourne Exhibition, we learn from the *Colonies and India*, has been visiting the Geelong vineyards, and reports that they are suffering from *Phylloxera* in the worst form, and ought to be totally destroyed.

PROF. DEWAR will give the first of his Christmas Lectures (adapted to a juvenile audience) on Atoms, at the Royal Institution on Tuesday next, December 28, at three o'clock

A BOTANICAL society for Northern Thuringia has been founded at Sondershausen by Prof Leimbach The new Society takes the title of "Irmischia," in memory of the celebrated botanist Irmisch, who died at Sondershausen last year. The immediate object of the Society, which has already a good

number of members, is the minute investigation of the Thuringian flora, and the making of botanical collections.

A GENERAL meeting of the Mineralogical Society of Great Britain and Ireland will be held at the Museum of Practical Geology, Jermyn Street, to day, at 8 p m. The following papers will be read.—"On Tyreeite," by Prof. M F Heddle, F R.S.E., "On Minerals New to Britain," by Prof. M. F. Heddle, F.R S.E., "Note on Gilbertite," by J H. Collins, F G.S, "On Brochantite," by Wm Semmons, "On a Remarkably Fine Crystal of Euclase," by M. Guyot, "On the Action of Organic Acids on Minerals," by Prof. H. C Bolton, communicated by J. H. Collins; "On Strontium from Westphalia," by Joseph J Acworth, F.C S, communicated by F. W. Rudler, F.G.S.

UNDER the common name of "Guaco" many plants are known belonging to different natural families, which have a reputation for curing snake-bites. In a recent number of the *Pharmaceutical Journal* particular attention is drawn to one of these guaco-yielding plants, the *Mikania guaco*, a composite plant of South America. The paper referred to is the substance of a letter received at the Royal Gardens, Kew, from a correspondent at La Salada, New Grenada, in which the writer gives his personal testimony as to the value of the remedy, and says that it forms the basis of all the preparations of the snake bite doctors of the district Notwithstanding that there are several species of snakes in the country whose bite is considered mortal, some killing in a very few hours, it is asserted by the writer of the letter, who has resided in snake-infested regions for many years, that properly and promptly administered the guaco is a sure cure for the bite of the most venomous An infusion or tincture of the leaves is used internally, and hot poultices of the bruised leaves and stem are applied externally.

THE Report on the Botanic Gardens, Georgetown, Demarara, for the half-year ending June 30 last has just been received. Its matter is mostly of local interest We note however that Mr. Jenman, the superintendent, refers in one part of the Report to the rapid growth of some introduced plants. "This," he says, "is more particularly shown by the roses obtained from England The hybrid perpetuals from average-sized nursery plants have in the three months which have elapsed since they were put out, grown into bushes from six to seven feet high, and the other hard-wooded things have hardly done less well, while herbaceous plants such as *Coleus*, *Alternanthera*, *Iresine*, *Amaranthus*, &c, appear to rush up to maturity in two or three weeks. Much of this luxuriance is due however to the very moist season experienced, as vegetation soon suffers and becomes stagnant with even a short period of drought in the stiff, tenacious soil of the coast land of the colony."

A PLANT recently introduced to Queensland by accident is reported to be giving some trouble in the colony in consequence of its poisonous effects upon cattle. The plant is *Xanthium strumarium*, and it is said to have been introduced along with cotton seed From experiments made with the plant by administration of the extract to some animals it seems at first that no particular symptoms were apparent, but after a period of about half an hour the animal becomes torpid and unwilling to move about. "The torpidity gradually increases, and without notable struggling or excitement the breathing ceases, after which the heart's action becomes feeble and stops. In weaker doses recovery of the functions of life takes place, and the animal appears little the worse for the experiment. The animals poisoned retained their intelligence to the last. An extract prepared from the common Bathurst Burr, *Xanthium spinosum*, gave similar results, though the stubborn character of this plant does not offer a tempting food for cattle, and they are not therefore poisoned by it." Both species are found as casual weeds in this country, though they are not considered to be indigenous.

ON the 7th inst. the distinguished Vienna anatomist, Dr. Hyrtl, reached his seventieth birthday He received numerous addresses from medical bodies in Austria, and congratulatory telegrams from all parts of the world.

IN Banjaluka (Bosnia) a distinct shock of earthquake was felt on the 6th inst. at 9 18 p m, direction north-east to south-west, duration four seconds. In Agram, on the 11th, a violent shock was experienced about 5 a m, and one less violent about 7 14 a.m. Since the 12th there have been no shocks there. The entire number of shocks at Agram during the earthquake period—November 9 to December 10—is (according to official data) fifty-nine. In Gurkfeld (Styria) shocks of brief duration were felt on the 11th inst. at 5 and 7 12 a m., direction south-east to north-west.

A SLIGHT shock of earthquake was felt at Charleville, Ireland, on Saturday morning It passed from the north-west to the south-east, and lasted for five seconds

THE new "Year-book of Photography" contains a nice portrait of Daguerre, the father of photography, from a daguerrotype taken in 1846 by Mr. J. E Mayall.

IN a moor of the Canton of Vaud (Switzerland) a well-preserved boat, dating from the age of pile-dwellings, has been found. It measures eleven metres in length and one metre in breadth, and has been conveyed to Lausanne.

THE ruins of a once magnificent bathing establishment have been recently discovered by Prof Giuseppe Novi not far from Herculaneum They are covered with a layer of ashes and lava of ten metres thickness. What has been brought to light up to the present is said to eclipse all previous discoveries of a similar nature both in Herculaneum and Pompeii The fountains and tanks of these "Terme" are made of oriental granite and adorned with sculptures The floors are of coloured glass mosaic; unfortunately it is but badly preserved. The walls of the various buildings are elegantly ornamented with paintings and stucco-work The excavations are to be continued

OUR ASTRONOMICAL COLUMN

SWIFT'S COMET —The evidence in favour of a period of about 5½ years instead of about 11 years for this comet is apparently strengthened by an able note from Mr. S C. Chandler, jun., which we find in an advance number of the Boston *Science Observer*. He brings the two periods to bear upon the representation of the observations of 1869. Starting with Prof Bruhns' parabolic elements in *Ast. Nach* No. 1788, he computed an ephemeris and compared therewith all the published observations, thirty-five in number, after taking into account parallax and aberration. The residuals were found to be considerable and systematic, and with the view to obtaining a nearer approximation to the orbit before proceeding with the determination of final elements, he formed three normals, using for the first all the observed places, six in number, from November 29 to December 1 inclusive; for the second all the places from December 8 to 10 inclusive, eleven in number, and for the third six observations between December 26 and 31: these observations were made at Hamburg, Konigsberg, Kremsmunster, Leipsic, Manheim, and Vienna; he thus gets for the foundation of his subsequent work the following normal positions:—

Washington M T	App R.A. h m. s	App. Decl ° ′ ″
1869, November 29 82475 ..	23 1 5·20 .	+ 15 51 57 7
December 8 81453 ..	0 3 37·28 ..	20 55 2·1
December 29·43628 .	2 39 22·08 ..	+ 26 30 56·8

From these data Mr Chandler calculates elements upon three different hypotheses: (1) that the orbit is a parabola; (2) that it is an ellipse with a period of 4006 days, or about 11 years (3) that it is an ellipse with a period of 2003 days, or about 5½

years, and he finds from these three orbits the following residual errors for the second normal place :—

	Longitude.	Latitude
	"	"
Parabola ..	− 3·1 ..	+ 25·7
11-year ellipse	− 0·6	+ 12·9
5½-year ellipse .	− 0·3 .	+ 4·1

Mr. Chandler finds that an attempt to reduce these errors in latitude on the assumption of a parabolic orbit or an elliptic orbit of 11 years' period, will only lead to intolerable discordances in the longitudes, and he considers that for both these hypotheses the residuals are far in excess of the probable error of the normal position. For the shorter period, on the contrary, the residuals seem well within reasonable limits of error, and his conclusion therefore is that the comet will be found to revolve in about 5½ years His ellipse with this assumed period is as follows, and will be found in close agreement with that obtained on a similar hypothesis from the observations of the present year, by MM Schulhof and Bossert, which we gave last week :—

Perihelion passage, 1869, November 18 59702 Washington M.T

	° ′ ″	
Longitude of perihelion .	42 58 53	M. Eq
,, ascending node	296 46 2	1869·0
Inclination	5 23 44	
Excentricity .	0 6581359	
Semi-axis major	3·10971	
Log. perihelion distance	0 0265728	

It appears that the comet was observed at Harvard College until January 3, 1870, or three days later than at any other observatory, and Prof Pickering has had these late observations very carefully reduced.

At the actual appearance a communication from Mr. Lewis Boss, Director of the Dudley Observatory at Albany, N Y, shows that the comet was micrometrically referred to a star, with the 13-inch refractor of that establishment, on the evening of October 11, but the declination of the comparison-star (B D. + 17°·4611) needs further examination, it might be referred to Bessel's star 385 following and about 6½′ north If good observations can be obtained towards the end of the present month the elliptic orbit may admit of pretty close determination from the observations of 1880 alone. The following ephemeris is calculated from MM. Schulhof and Bossert's ellipse of 5½ years .—

At Greenwich midnight

	R.A	Decl N	Log Δ.
	h m s	° ′	
Dec 23	5 28 18	35 3 4	9 3514
24	5 30 38	34 28 9	
25	5 32 51	33 55·6	9 3736
26	5 34 58	33 23·4	
27	5 36 59	32 52 5	9·3957
28	5 38 55	32 22·6	
29	5 40 47	31 53 7	9·4177
30 .	5 42 35	31 25 8	
31	5 44 19	30 58 9	9·4828
Jan. 1	5 45 59	30 33 0	
2	5 47 35	. 30 8 0 ..	9 5041
3	5 49 7	29 44 1	
4 .	5 50 34	29 21 2	9 5252
5 .	5 51 56	28 59·2	

A New Comet —A small, pretty bright comet was discovered by Dr Pechule at Copenhagen on the evening of December 16, in R.A. 18h. 49m., Decl. + 10° 30′. Daily motion, + 5m. and + 40′.

Occultation (?) of 73 Piscium by Jupiter.—On February 3, 1881, according to Leverrier's Tables of the planet Jupiter and the position of the star 73 Piscium (rated 6 om. in the *Durchmusterung*) brought up from the Greenwich Catalogue of 1872, the star should be occulted by the planet about 2h 8m G.M.T. Very small change however in the place or semi-diameter of the planet, might suffice to bring about merely an appulse. The facts of the case may be well ascertained in easterly longitudes, as at Madras, where the conjunction in Right Ascension appears to occur when the planet is 3h. 26m. past the meridian, about 7h 29m. mean time. The apparent place of the star on February 3 is in R.A. 0h. 58m. 43·53s., Decl. + 5° 1′ 10″·2. The polar semi-diameter of the planet, according to the value of mean semi-diameter now adopted in the *Nautical Almanac*, will be 17″ 2, and allowing for parallax, this seems to place the star a little over 2″ within the planet's northern limb.

METEOROLOGICAL NOTES

From an able and temperately-worded article in the New York *Nation* on the Signal Service Succession, it is plain that meteorology is in a critical position in the United States at the present moment The whole question of the future of meteorology in that country practically turns on the sort of man who is to be appointed to succeed the late lamented Gen Myer As regards the bearing of the question on the promotion of the great financial, commercial, and educational concerns of the country, the writer of the article well puts it when he states that "it depends altogether on the future management of the office whether its activity shall be confined to a lifeless routine without any attempt to make new discoveries or introduce improved methods, or whether it shall be animated by that progressive spirit which will not be satisfied until every man within reach can be informed of coming meteorological changes as long in advance as it is possible for them to be foreseen" To accomplish this end much more is needed than a most diligent discharge of the daily duties of the office, such as will put the public in possession of forecasts drawn up on the lines that have hitherto been followed in forecasting the weather It was an essential feature of General Myer's procedure that in framing the forecasts in the office he confined himself simply to making the best use of what was already known of meteorology But whilst this continued the practice of his office, he had the genius to see that if the system of forecasting weather is to make way it is absolutely indispensable to strike out entirely new lines of observation with the view of arriving at some positive knowledge of the great movements of the atmosphere and their determining causes. Hence his great scheme of International Meteorology, by which was secured one daily observation at the same physical instant, where possible, over the globe, and the regular publication of the monthly results in the U S Weather Maps, with which our readers are familiar. These admirable maps, together with the Weather Maps of the States themselves, published at intervals of eight hours through a period of ten years, now furnish a mass of material the value of which it is not possible to overestimate, and the adequate discussion of which, it may be very safely said, is the next great step to be taken by meteorology This step it is in the power of the United States to take, and whether it be taken or not depends almost wholly on the character of the man who may be called to fill the place so suddenly left vacant by General Myer's premature decease What, above all, is imperatively required, is a sympathy with science and workers in science, so strong and so decided that he will, without fail, enlist in the service of his country some of the best intellects who will give their time and their energies to work out the great problem of weather prognosis

The American mails inform us that a frost of unusual severity for the season set in over Canada and the middle States on November 19. It came so suddenly and with such intensity that vessels of every description were frozen up and fixed, in many cases in mid-stream The cold was greatest all along the St. Lawrence, where the thermometer ranged from zero to − 10° 0. Several ocean steamers, even, were placed in a very precarious position, and altogether it is estimated that 800 vessels laden with grain, potatoes, fruit, and other produce were frozen up, and many deaths have occurred in consequence of the frost So early and intense a frost has not been experienced in Canada since 1873 Closely following it occurred a remarkable depression of temperature in the British Islands, which as regards certain districts in North Britain was unprecedented at so early a period in the winter months. It was an accompaniment of a wide-spread area of high pressure which appeared off the north-west of Scotland on the 20th as shown by the English and German daily weather maps. On this day temperatures fell low for the season, particularly along the west from Cornwall to Shetland. On the 21st the high-pressure area had advanced a considerable way towards the south east, and under the clear skies and light winds which characterised it, the temperature fell in many places in Scotland to a degree which would have been noteworthy in the depth of winter. The protected thermometer fell at Aboyne Castle on Deeside to zero, and to 1° 0 at several places, viz., at Lanark in Clydesdale, at Stobo Castle near the head of the Tweed, and at Thirlestane Castle on the Leader. These low temperatures were approximated to at a considerable number of the other stations of the Scottish Meteorological Society situated in the larger valleys in in-

land situations. As on similar occasions, the influence of the sea in arresting the fall of temperature was strikingly seen. Thus the minimum temperatures on the 21st were 31°·7 at Portpatrick, 8°·3 at Drumlanrig Castle on the Nith, 1°·0 at Stobo Castle and Thirlestane Castle, 11°·7 at Milne Graden near Coldstream, and 17°·7 at Eyemouth on the East Coast. At Douglas Castle and Thirlestane Castle the unprotected thermometer fell to −6°·0.

MR. H. S EATON has rendered a great service to meteorology by a paper on the average height of the barometer in London, which has just appeared in the *Journal* of the Meteorological Society for October. The great value of the paper consists not so much in the long period of 100 years for which the monthly averages of each year are given, as in this, combined with a careful and laborious elimination of instrumental errors and errors arising from breaks of one or more days in the observations of the months. The series is sufficiently extended as to entitle it to be considered one of the most valuable we possess in dealing with questions of secular meteorological variations. The mean atmospheric pressure at 32° and sea-level for London is 29·952 inches, the mean monthly maximum 29 996 inches occurring in June, and the minimum 29 900 inches in November, the mean for October being nearly as low, viz., 29 909 inches. In a discussion which followed the reading of the paper Mr Strachan remarked that even another 100 years' observations would not alter the positions of these points of the London curve—a remark no doubt quite true for London On advancing however to the south-west the means for June and July approach towards equality, and ultimately the July mean becomes the larger as we advance into the region of high pressure which occupies the Atlantic to the south-west during this month On the other hand, as we proceed northward, the means for May and June approach towards equality till about the south of Scotland the mean for May becomes the maximum for the year, and the further north the more decidedly is May the maximum, till in Iceland it exceeds the mean of any other month by the tenth of an inch. Attention was drawn to the dips in the curve of pressure for April and July. These in all probability are permanent features in the London curve of pressure for March-April and July when drawn from a long average, since the former is connected with the east winds of spring and the latter with the great summer barometric depression which falls to the lowest point in July in the interior of the Europeo-Asiatic continent.

IN the same number Mr. Marriott gives a brief *résumé* of three years' observations made by Mr. F. E. Cobb at Stanley, in the Falkland Islands, which, from the geographical position of the place, possess some interest The results show a mean annual pressure of 29 604 inches, the maximum occurring in winter, and the minimum in summer. A singular feature of the monthly means is their comparative steadiness from year to year, the highest being 29 819 inches for August 1876, and the lowest 29·342 inches for February of the same year The difference of these two extremes is only 0·477 inch. It would be difficult to select from Mr. Eaton's 100 years mean pressures for London any consecutive three years which would show so small a variation between their two extreme monthly means as do these Falkland Islands' observations The prominent features of pressure in those islands would appear to be its variability, the constant recurrence of rapid changes, and the comparative absence of protracted periods of very low, but especially very high pressures—occasioned in all likelihood by there being no great mass of land in that quarter of the globe. A like equableness from year to year characterises the temperature and rainfall of the climate. The rainfall is surprisingly small, amounting only to twenty inches in the year; but the falls, though not heavy, are frequent, there being 236 rainy days in the year. The lowest mean temperature of any of the thirty-six months was 35°·4, and the highest 52°·6. The climate is eminently a dripping one, and when the range of its temperature is taken into consideration, and its high winds, it is one of the most disagreeable climates of the globe.

GEOLOGICAL NOTES

NAINI TAL LANDSLIP.—In NATURE, vol. xxii. p. 505, attention was directed to landslips in connection with the catastrophe at Naini Tal on September 18. We have just received part 4 of vol. xiii. of the *Records* of the Geological Survey of India, containing a paper by Mr. R. D. Oldham, of the staff of that Survey, who was deputed to examine and report on the landslip to the Director. From this paper and a note appended to it by Mr. Medlicott, it appears that we were in error in supposing Naini Tal to stand upon Tertiary rocks. It lies just to the north of the younger formations, and is situated upon "more or less imperfectly-cleaved clay slates." These rocks are subject to a decomposition which penetrates deep into their mass, and it would seem to have been the cover of loose, decomposed detritus which, thoroughly saturated with water from the heavy rains, slid down the hill, and gave rise to the catastrophe.

THE "CHALLENGER" WORK —Steady progress is being made in the investigation of the deep-sea deposits dredged up by the *Challenger* Expedition. M. Renard has established himself at Edinburgh, where, in concert with Mr. J. Murray, he is busily engaged in subjecting the various dredgings to chemical and microscopic analysis. In the first volume, devoted to an account of the bottom of the ocean, will be gathered together the facts amassed during this laborious study. It will avoid all speculation, but will contain such a body of data for the explication of the sedimentation and chemistry of the ocean abysses as has never before been available In a subsequent volume the authors will develop the views to which their prolonged and minute investigations have led them No part of the work of the *Challenger* promises to possess a profounder interest in geology.

GEOLOGICAL SURVEY OF BELGIUM —The dual organisation for the Geological Map of Belgium is likely to lead to some curious reduplications and complications Besides the staff under the direction of M Dupont, there are other geologists independently at work under the Ministry of the Interior who are determined to lose no time in bringing out sheet after sheet of the geological map as surveyed by them. In particular the Baron O Van Ertborn and M Paul Cogels have been eminently energetic. The Baron made a convention with the Ministry towards the end of last year to complete six sheets with their explanatory texts before June 1 of the present year. He has been able to keep his engagement except as regards the Lubbeek sheet, for which he obtained a delay until the close of this year We have just received the Boischot and d'Aerschot sheets Meanwhile M Dupont makes no sign. Specimens of his map were seen at the Paris Exhibition in 1878, and also at the Dublin meeting of the British Association last year But so far as we are aware, nothing has yet been issued The Director is understood to be resolved to make his map the most perfect geological map that has ever been published. It is being chromolithographed at Leipzig. Considerable interest is naturally felt among geologists to see the first completed specimens of this long-expected work. We are curious also to know what will happen when the Official Survey and the free-lances meet on the same ground Will the Government publish two different geological maps? The position reminds us of that which roused the activity of the Congress of the United States a few years ago, when it was discovered that the same Territory in the far West was sometimes independently surveyed by two or three different organisations, all paid out of the public purse. Only in Belgium things are worse, for the country is small, and the certainty of reduplication must have been foreseen from the beginning.

GEOGRAPHICAL NOTES

AT the meeting of the French Geographical Society on November 19, M. Henri Duveyrier read an important memorandum which he had drawn up on the subject of the sources of the Niger. After going carefully into the question of Major Laing's prior discovery and various matters relating to the hydrographic system of the Niger basin, he thinks it very doubtful if any other stream will ever be discovered having a right to be deemed the chief source of the river, than the Tembi-Kundu visited by MM. Zweifel and Moustier. M Duveyrier's remarks will no doubt be published in an early number of the French Geographical Society's *Bulletin*, and it may be hoped that it will be illustrated by a large scale map. At the annual meeting of the Society last Friday, M. Maunoir read his usual report on the work of the Society and the progress of geographical knowledge. It was announced that the Society had now about 2100 members, being an increase of about 100 in the year.

HEFT 3 of vol. ii. of the *Mittheilungen* of the German African Society contains a brief report of the work of the year. The

most striking feature of the work is the successful journey of Dr. Lenz from Morocco to Timbuctoo and thence to St. Louis in Senegal. In the region to the south of the Congo some good work has been done. Dr. Buchner has probably got beyond the district known as the kingdom of Muata Yanvo, while Major von Mechow has reached the Coango from Malange by following down the valley of the Cambo, a tributary of that river. The navigation above the junction is obstructed by cataracts, but Major von Mechow did not expect to meet with any difficulty in sailing down the Coango to its mouth in the Congo. Dr. Pogge is on his way out to Portuguese West Africa to proceed to the interior to found a station at Mussumba, the chief town in Muata Yanvo's kingdom. Herr Flegel has been exploring the Niger in the *Henry Venn*, and expects shortly to reach Sokoto. Dr. J. Hann has a paper in this number on the meteorological and hypsometrical results of Rholfs' expedition to the Kufra Oasis. The Society have received instructions from the Imperial Government regarding the manner in which the 3750*l.* granted by the Reichstag is to be divided. Dr. Gerhard Rohlfs' expedition to Abyssinia will receive 1600*l.*, and 150*l.* is to form a reserve fund for this same undertaking. The expedition now being organised at Zanzibar under the leadership of Herr von Scholer will receive 800*l.*, and the remaining 1200*l.* are for Dr. Pogge, who is attempting to reach the capital of Muata Yanoo, in Central Africa, in order to found a station there. The Society has also granted 250*l.* to Herr R. E. Flegel, who ascended the Binue River this year.

THE new number (No. 9 of vol. vii.) of the *Verhandlungen* of the Berlin Geographical Society contains papers by Herr Gustav Niederlein on some of the scientific results of an Argentine expedition to the Rio Negro in Patagonia, and by Dr. Nachtigal on the ethnological place of the Tubu and Kanuri.

THE December number of *Petermann's Mittheilungen* contains an interesting paper by Dr. Rholfs on the Libyan Desert, in which he shows that it is the eastern part of the Sahara, and not the western, that is the real desert, broken only here and there by oases. Indeed the extreme west of the Sahara, for a distance of from 400 to 500 kilometres from the coast, does not strictly belong to the desert at all, and even the eastern half, the more we know of it, the more numerous are its oases found to be. There is an eclectic article on the Liu-Kiu Islands, by Dr. v. Kloden, a paper on the New Volcano on Lake Ilopango, and a map of the South Coast of Franz Josef Land, based on Mr. Leigh Smith's recent discoveries. In the *Monatsbericht* some interesting details are given of Dr. Junker's journey to and his sojourn in the Niam-Niam country. A letter from Dr. Emin Bey, the Governor of the Egyptian Equatorial Province, informs us that Mtesa, King of Uganda, whom Mr. Stanley so whitewashed, is as tyrannical and bloodthirsty as ever, and does not intend to be either Christianised or Mohammedanised, but to adhere to the ways of his forefathers. Dr. Emin is anxious that explorers should turn their attention to the Equatorial Province, which forms a splendid field for botanists, zoologists, and other specialists.

NOTWITHSTANDING the belief in some quarters that the American Arctic steamer *Jeannette* has been lost with all hands, it is thought in San Francisco that Capt. De Long and his staff and crew may have only abandoned her, and be waiting succour at some point. An attempt is therefore being made to get a small schooner sent out next spring to search Wrangell Land.

EARLY in the present year Mr. W. H. Cornish, of the Surveyor-General's Department at Adelaide, was engaged for some two months in examining the country in the far interior for the extension of the trigonometrical survey and traverse of the Herbert River. In about lat. 30° 59′ near that river he crossed a piece of country which by his account almost baffles description; it was flood country of the Herbert, and was completely rotten. "Cracked ground," he reports, as a term is scarcely applicable, for there were yawning chasms from four to five feet deep, and even deeper, and eight to twelve inches wide at every few feet. The country indeed was so bad that it took the camels six hours to travel seven miles, and Mr. Cornish's difficulties were increased by the unusually intense heat of the weather. Mr. Cornish believes that before long the cattle-trade from the part of Queensland which he visited will go southwards to Australia as soon as the settlers who are beginning to open up the country on the Herbert, Diamantina, and Mulligan become sufficiently acquainted with the means of communication. During his journey Mr. Cornish did not see more than 300 natives, who were all friendly, but he believes there are large numbers in the region he travelled through, and that it would not be prudent to trust them.

DR. LAWS, the head of the Livingstonia station on Lake Nyassa, is actively engaged on linguistic work. He has translated various portions of the New Testament into Chinyanja, and the Laing trustees have agreed to publish his translation of St. Mark's Gospel. Dr. Laws has also begun the Yahitonga language spoken at Bandawi, and he has collected a short vocabulary of the Chungu dialect at the north end of the lake. The Livingstonia and Foreign Missions Committee of the Free Church of Scotland have recently agreed that, on the assurance that there will be no difficulty there as to civil government, owing to the presence of powerful chiefs, Bandawi shall be made the principal port of the mission on Lake Nyassa, while sanitary out-stations are to be sought on the neighbouring hills among the Angoni. As soon as possible however the east side of the lake is to be explored, in the hope of finding a better sanitarium on the so-called Livingstone Mountains.

MESSRS. GRIFFITH AND HUTLEY, who lately established the first mission station on the west side of Lake Tanganyika at Mtowa, near the mouth of the Lukuga Creek, have sent home to the London Missionary Society some information respecting the religious notions of the Waguha. There appears to be a marked difference on this point between the tribes on the opposite shores of the lake. Those on the east side have no images or idols, but on the west shore they have them in great numbers, and have certain beliefs connected with them. Mr. Griffith observes that the first thing which strikes the African traveller on entering the western half of the continent is an image at the entrance of every village, besides many others inside it. The image is in imitation of the human figure, and is called *Mkisi*, which is the same as the Mzimu of the Swahili, and means spirit.

THE new *Bulletin* of the Belgian Geographical Society contains reports relating to the International African Association's expeditions in East Africa, including tables of meteorological observations taken by M. Popelin. There is also a report on the "Conférence Géodésique Internationale de Munich," and an essay by Col. Verstraete on biological geography.

THE *Bulletin* of the Norman Geographical Society contains a paper by M. G. Gravier on M. Paul Soleillet's journey to Adrar between December, 1879, and May, 1880, as well as the continuation of M. Ch. Benner's journey from M'ruli to the capital of Unyoro.

THE Italian Expedition to the Antarctic Regions will not set out till 1882, but Lieut. Bove will shortly set out on board a whaling vessel to make a voyage of reconnaissance.

TWO Englishmen, with sixteen men belonging to an Indian convoy, are reported to have arrived at Yarkand from the direction of Tibet, whither they returned after visiting Kashgar.

M. RABOURDIN, who accompanied Col. Flatters on his survey for the proposed Trans-Saharan Railway, reports that he discovered numerous remains of cut flints, not less than eighteen manufactories being found in a length of 800 kilometres from Wargla. He also found remains of the great horned oxen which, according to Herodotus, were found in the country of the Garamantes.

DR. NACHTIGAL has furnished the *Tour du Monde* with a *résumé* of the concluding portion of the forthcoming volume of his "Reise in Afrika" in advance of publication, and it now appears in that periodical under the title of "Voyage du Bornou au Baguirmi," accompanied by a sketch-map and some very interesting illustrations.

WE hear that the Geographical Society of Marseilles have awarded their gold medal to Major Serpa Pinto for his journey across Africa.

ACCORDING to the *Echo du Japon* the King of Corea has been induced to make an offer of entering into treaties with foreign powers, through his fear of his kingdom being annexed by Russia, and he has despatched two envoys to open negotiations. Though the opening of Corea will hardly be of any great commercial importance, it will pave the way for interesting geographical researches in a country which is almost unknown, except from the imperfect accounts of Roman Catholic missionaries.

THE first volume of Lowenberg's "Geschichte der geographischen Entdeckungs- und Forschungsreisen," which treats

of voyages of discovery made during antiquity and the middle ages, as far as Magellan's first voyage round the globe, will be shortly published by Herr Spamer of Leipzig It will contain some 100 illustrations, besides maps, charts, &c.

CRITICAL TEMPERATURE OF ETHYLENE

M. AMAGAT (*Compt. rend.*[1] [1879], lxxxix. p 437, corrected *Beiblätter* [1880], iv. p. 19) has submitted hydrogen, oxygen, nitrogen, air, carbon monoxide, methane, and ethylene at temperatures from 18° to 22° to pressures ranging between 28 and 431 atmospheres, and finds that, except for hydrogen, the product $p v$ first diminishes and then increases as p increases, the most marked case being that of ethylene, for which the values of $p v$ at 31 58, 84 16, 398 71 atmospheres are proportional to 2 29, 1, 3 13 respectively. Dr. van der Waals deduced this general peculiarity theoretically in 1873, and showed that its markedness is the greater, the less the temperature of compression exceeds the critical temperature concluding, therefore, that for ethylene the critical temperature is not far below 18°, as M. Amagat has also surmised, he has recently (*Meded. der k Akad. van Wetenschappen in Amsterdam*, Mei 1880)[2] determined it directly by a Cailletet compression-apparatus, finding it to be 9° 2, and the critical pressure 58 atmospheres

On p. 55 of his dissertation "Over de Continuiteit van den Gas- en Vloeistoftoestand" (Leiden, 1873), van der Waals finds the characteristic equation of a gas in the form—

$$\left(p + \frac{a}{v^2}\right)(v - b) = R(1 + \alpha t),$$

where a, b, R are constants and α the coefficient of expansion, and on p. 79 *et seq* it is shown that at the critical temperature all three values of v given by this equation, which may be written

$$v^3 - \left\{b + \frac{R(1 + \alpha t)}{p}\right\}v^2 + \frac{a}{p}v - \frac{a b}{p} = 0,$$

are equal hence, if V is put for this common value of v, and T, P for the corresponding values of t, p, *i e* for the critical temperature and pressure, the theory of equations gives

$$3V = b + \frac{R(1 + \alpha T)}{P},\quad 3V^2 = \frac{a}{P},\quad V^3 = \frac{a b}{P},$$

whence

$$P = \frac{a}{27b^2},\quad V = 3b,\quad P V = \frac{a}{9b},\quad 1 + \alpha T = \frac{8a}{27 b R},$$

and also

$$a = 3PV^2,\quad b = \tfrac{1}{3}V,\quad R = \tfrac{8}{3}\frac{PV}{1 + \alpha T}.$$

The minimum value of $p v$ at any temperature t may be determined in the usual way by $\frac{d\, p v}{d v}$ being equated to zero, and, if p', v' are written for the corresponding values of p, v, there result

$$v' = \frac{V}{3(1 - \tau)},\ p' = 27(1 - \tau)(2\tau - 1)P,\ p'v' = 2(2\tau - 1)PV,$$

where

$$\tau^2 = \frac{b R(1 + \alpha t)}{a} = \tfrac{8}{27}\frac{1 + \alpha t}{1 + \alpha T}.$$

Thus a minimum value of $p v$ exists only when

$$1 > \tau > \tfrac{1}{2},$$

i e. only at temperatures that lie between

$$\frac{a}{b R \alpha} - \frac{1}{\alpha} \text{ and } \frac{a}{4 b R \alpha} - \frac{1}{\alpha}.$$

If p_1 represents the pressure of the gas when occupying unit volume at t, then

$$(p_1 + a)(1 - b) = R(1 + \alpha t),$$

and, p_1 being the value of $p v$ in this initial state, the markedness of the minimum value of $p v$ is greater the less

$$\frac{p'v'}{p_1} \text{ or its equivalent } \frac{(1 - b)(2\tau - 1)}{\tau^2 - b(1 - b)},$$

that is, since the sign of the t differential coefficient of this expression is the same as that of $(\tau - b)(1 - b - \tau)$, the less t, provided that

$$1 - b > \tau > b,$$

or that the temperatures lie between

$$\frac{a(1 - b)^2}{b R \alpha} - \frac{1}{\alpha} \text{ and } \frac{a b}{R \alpha} - \frac{1}{\alpha}.$$

If v represents the volume of the mass of gas which occupies unit volume at 0° under unit pressure, then

$$R = (1 + a)(1 - b),$$

as is taken in the following calculations.

In the case of ethylene van der Waals' experiments give $T = 9 2$ and $P = 58$; hence, by the above relations with $\alpha = 0 00367$,

$$\frac{a}{b(1 + a)(1 - b)} = 3\,489,\quad \frac{a}{b^2} = 1566,$$

which lead to a cubic equation that gives

$$a = 0\,00786,\ b = 0\,00224,\ R = 1{\cdot}0056,$$

so that the characteristic equation is

$$p = \frac{0\,0037(272{\cdot}5 + t)}{v - 0\,00224} - \frac{0\,00786}{v^2},$$

the pressure being reckoned in atmospheres, hence too $V = 0\,0067$ and $P V = 0\,39$ Further, when $t = 20$, the mean temperature in Amagat's experiments, $\tau = 0\,5547$, and thus by calculation $p' = 76{\cdot}25$, while Amagat's direct observations give $p' = 84$ approximately, so far justifying the the theory The temperatures for which $p v$ has a minimum value range from 678° to − 35°.

The intimate agreement between Amagat's experiments and van der Waals' formula (which is entirely independent of them) is shown by the following table, wherein the first column contains the pressures (expressed in atmospheres) employed by Amagat, the second his experimental values of $p v$ divided by 23500, and the third the values of $p v$ calculated for $t = 20$ from the formula —

p	$p v$ observed	$p v$ calculated
31·58	0·914	0·895
45·80	0 781	0 782
59 38	0 522*	0 624
72 86	0 416	0·387
84 16	0·399	0 392
94·53	0·413	0 414
110 47	0 454	0 456
133 26	0 520	0 520
176 01	0 643	0 642
233 58	0 807	0 805
282 21	0 941	0 940
329·14	1·067	1 067
398 71	1 248	1 254

The only serious discrepancy occurs for $p = 59\ 38$, and van der Waals accounts for this by supposing that in Amagat's table 12263 is misprinted for 15263, so that the asterisked number should be 0·650; for by experiment he finds that the ratio of the values of $p v$ for $p = 45\ 80$ and $p = 59\ 38$ is 1 26 (the calculated ratio being 1 25), while Amagat's actual numbers give 1 50, but, when corrected, 1·20

For methane the equation of van der Waals' form that best satisfies Amagat's experimental values has for constants $a = 10^6 \times 2{\cdot}9$, $b = 53$, $R = 25525$, if $t = 20$, $\alpha = 0{\cdot}00367$, pressures being measured in metres of mercury, and this gives $-99\tfrac{1}{2}°$ for the critical temperature and $50\tfrac{1}{4}$ atmospheres for the critical pressure. The constants have large values here, for, as calculation shows, the mass of the gas considered is about $24\tfrac{1}{4}$ grams, which would occupy, at 0° under one atmosphere, about 33518 c c.

This discussion—with the numbers recalculated—by Dr. van der Waals of M. Amagat's experiments in connection with the critical temperature is here reproduced, together with the brief *résumé* of his theory (which has not hitherto appeared in an English dress), for ready application in other cases.

September 17 ROBERT E. BAYNES

[1] Since the following was written, M. Amagat has published further results, which do not however affect its main point

[2] Mr Dickson seems to have independently discovered (*Phil Mag* for July, 1880) the principles laid down by Dr. van der Waals in his above mentioned dissertation, pp 79-93, which is not sufficiently known in England

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE —The Natural Science Tripos Class List has just been issued There are eight names in the first class, eight in the second, and fifteen in the third Of those in the first class three attain their first class for Physics and Chemistry, viz.: Fleming, St. John's (distinguished in Physics); S L. Hart, St. John's, and Heycock, King's. Two attain their first class for

Botany: Hillhouse, Trinity, and Hoffmeister, Caius (distinguished), and three for Zoology, Anatomy, and Physiology: Caldwell, Caius; Pigeon, Christ's, and Shaw, Sidney

Mr. J. A. Fleming, B.A., of St John's, has been appointed to the new post of Demonstrator of Mechanism and Applied Mechanics, Mr Fleming is a distinguished graduate of London University, as well as having attained distinction in Physics, with first class honours in the Natural Science Tripos of this year

Mr. J. J. Lister, B A, of St John's College, has been appointed Demonstrator of Comparative Anatomy, in place of Mr A C Haddon, who has been appointed to the Professorship of Zoology and Comparative Anatomy in the Royal College of Science, Dublin, vacated by Prof. Bridge

Mr. A H Cooke, B A, Fellow of King's College, has been appointed Curator of the Zoological Museum.

SCIENTIFIC SERIALS

Annalen der Physik und Chemie, No 11.—Magnetic researches, by F Auerbach.—New researches on magnetism, by C. Baur.—On so called polar induction, by E Riecke.—Determination of the absolute velocity of current electricity from Hall's phenomenon, by A v. Ettingshausen.—Method of calibration of a wire for galvanic measurements, by W Giese.—Action of gases and vapours on the optical properties of reflecting surfaces, by P Glan.—On a new interference photometer, by Fr. Fuchs.—Influence of the density of gases on their conduction of heat, by A Winkelmann.—Currents of liquids resulting from unequal temperature within them, by A Oberbeck.—Theory of the interference-phenomenon presented by dichroitic crystal-plates cut at right angles to the axis, by E Ketteler.—On the polarisation of diffracted light, by M. Rethy.—On changes produced in the spark and brush phenomena by coverings of the electrodes, by W Holtz.—On atmospheric refraction of sound rays, by A Kneser.—Double acting mercury pump without cock, by F. Neesen.—Alteration of Rudorff's absorption-hydrometer, by the same.—Reply to a note by O E Meyer, by L. Boltzmann.—Remarks on U Duhring's paper on the law of corresponding boiling temperatures, by A Winkelmann

SOCIETIES AND ACADEMIES

London

Zoological Society, December 14.—Prof W H Fowler, LL.D., F.R.S., president, in the chair.—Mr. Sclater exhibited and made remarks on a skin of a brown female of *Pauxis galeata*, formerly living in the aviary of the late Mr G. Dawson Rowley, F Z S.—Dr. A. Gunther, F R S, exhibited and made remarks on a skin of a new species of *Rhynchocyon* from Eastern Africa, discovered by Dr Kirk.—Prof. T. H. Huxley, F.R S, read a paper on the application of the laws of evolution to the arrangement of the Vertebrata, and more particularly of the Mammalia.—Lieut. Col. H. H Godwin-Austen, F R.S, read a paper on the anatomy of *Ferussacia gronoviana*, Risso, from Mentone, pointing out its general relationship with *Lovea tornatellina*, Lowe, of Madeira, and with *Ferussacia folliculа*, Gronov., from Algiers.—Mr Arthur G Butler read a paper on a second collection of Lepidoptera made in Formosa by Mr. H. E Hobson. Thirty-three new species were found in this collection.—Mr Oldfield Thomas, F.Z.S., read a paper containing the description of a new species of *Reithrodon*, obtained in Venezuela by the late Mr D. Dyson, which was described as *Reithrodon alstoni*.—Dr. A. Gunther read a paper containing notes on some rare reptiles and batrachians now or lately living in the Society's Gardens.

Physical Society, December 11.—Prof. W. G. Adams in the chair.—New Members: Mr. W. R. Brown, Mr. T. Mightson, C.E.—Lieut L. Darwin read a paper on the rate of loss of light from phosphorescent substances. His experiments were made at Chatham on Balmain's luminous paint, by comparing the intensity of the phosphorescent light with the light of a sun-burner; the luminous surface being kept cool by placing ice and water near, as a slight increase of temperature in the surface considerably increases the quantity of light given off in a certain space of time. The supply of light was communicated to the paint from a mirror reflecting sunlight. A table and a curve exhibited to the meeting showed the rate of loss found by Lieut. Darwin. It is independent of the original intensity of the illumination. According to the curve the light diminishes very nearly in proportion to the square of the intensity of the light. In a report on the use of Balmain's paint in mines, it had been stated that the phosphorescence became brighter a few minutes after exposure in the dark, but the curve showed this to be an error, due probably to the fact that the eye becomes more sensitive to light after being a few minutes in the dark. Mr Pearsall emphasised the advantages of such a light in fiery mines. Prof Guthrie inquired if the phosphorescent power grew weaker by time, and Lieut. Darwin instanced a specimen eighty years old to the contrary, but Dr W Crookes stated that these luminous substances give off sulphuretted hydrogen in damp air and deteriorate. If sealed in a vacuum they would not. Dr. Crookes remarked that in Balmain's patent it was stated that the phosphorescence died out sooner when exposed to a strong light for a short time than to a weak light for a longer time; but Lieut. Darwin thought this was explained by the slow decrease in the lower part of the curve when the phosphorescence became faint. Mr R J. Lecky mentioned that Evelyn in his Diary (1650) describes a phosphorescent powder as "bottling up" sunlight. Dr Coffin inquired if short exposure to strong light was equivalent to long exposure to feeble light. Lieut Darwin thought not.—Dr C R Alder Wright read a full paper on the determination of chemical affinity in terms of electromotive force. He considered first the value of the B A unit of resistance, which from different experimenters might be taken as really 1.005 earth quadrants per second, or not more than half per cent. out. Clark's element when carefully prepared was practically correct at 1.457 volts, and it kept constant for three or four months after being made, but deteriorated thenceforth some 3 per cent in about two years. The deterioration was assisted by air, which could not be well excluded by the paraffin cork, as it cracked. If sealed in a Sprengel vacuum the element lasted better. Joule's mechanical equivalent of heat (*J*) he estimated at 42×10^6, or not over 1 per cent greater than Joule's water value. The chief result of Dr Wright's researches was the conclusion that the action of a current in electrolysis is to decompose the electrolyte into "nascent" products which evolve heat in changing into ordinary products of electrolysis. These nascent products may be the ultimate atoms composing the molecules of the ordinary products, and the heat is given out in these atoms coming together to produce molecules, say of oxygen and hydrogen in the case of water. A number of deductions from this theorem are verified by experiment. One of these is that no gas battery can give a higher E M F than 1·5 volts. A result, not before published, is that the E M.F of a Daniell cell is a function of the current and is a maximum when the current is indefinitely small. The variation may amount to 10 degrees. Therefore all methods of determining resistance by means of two currents of different strength are inaccurate. Dr Wright's experiments also verified Faraday's law that conduction in an electrolyte is always accompanied by electrolysis. Prof. Adams inquired if Dr Wright had seen the letter of Prof Rowland's assistant to the effect that Dr. Wright's former estimate of the ohm was on the wrong side of unity. He had been too busy to see it. Prof Foster thought that the variation of E M F in a cell with the current was to be expected, and was probably due to the slowness of diffusion. Dr Wright thought diffusion would account for it. Dr Lodge said that there was no way of measuring the resistance of a cell except by employing two currents of different strength, and therefore it was necessary to know the law of variation of E M F. with current strength. Dr Wright stated that he had found two methods of proceeding with currents of the same strength. With regard to the deduction of Dr Wright that no current passes without producing electrolysis, Mr Walenn inquired if the ordinary law of solution held when there was no evolution of hydrogen, and was answered in the affirmative.—Prof. Guthrie cited the experiments of Mr. C V Boys and himself on the conductivity of liquids as an instance of a current passing without electrolysis, or if there was decomposition it was followed by instant recomposition. Dr. Wright thought there must be electrolysis in Dr. Guthrie's experiments (which were conducted by rotating a glass vessel filled with the liquid between the poles of a magnet, after Arago's experiment), because some two parts of the rotating vessel would be at different potentials, and a current would be set up in the liquid.—The Society then adjourned till after Christmas.

Paris

Academy of Sciences, December 13.—M. Edm. Becquerel in the chair.—The following papers were read:—Solid and

liquid products which continued issuing in April, 1880, from a crater of Dominica (English Antilles), by M. Daubrée. The lake of boiling water which filled the crater in January had shrunk to a boiling-spring, the dark liquid from which joined a river. The weight of solid matter is nearly half the liquid, and mainly consists of silica and alumina; there is also iron oxide, with carbonate of lime, &c. Chloride of potassium abounds in the water.—Order of appearance of the spikelets in the ear of Lolium, by M. Trécul.—On the orbit described by a material point which is attracted by a spheroid, by M Gyldén.—M. Abria was elected Correspondent in Physics in place of M. Lissajous —Application of the theory of germs to parasitic champignons on plants, and especially to diseases of the vine, by M Cornu. In some cases the diseased leaves may be variously utilised, after such treatment as will prevent the spores being disseminated when their time of vegetation comes. Other kinds of parasites do not allow of the leaves being used as food for cattle, compost, or litter. Their dormant spores are not killed by digestion or putrefaction of tissues; after prolonged burial they may produce new germs. The *débris* in that case should be burnt. Oïdium and anthracnose exemplify the former, *peronospora* the latter —On the discovery of the winter egg in the Eastern Pyrenees, by M. Campana He found three in the end of September.—On a process of preparation of sulphide of carbon in the solid state for treatment of phylloxerised vines, by M. Lafaurie. He solidifies the sulphide by making an emulsion of it with a solution of algæ (Japanese moss does very well). The proportion of sulphide may be varied up to 80 per cent. It evaporates very slowly, so that vapours can be thus maintained a long time about the roots —Swift's comet (*e* 1880), by MM. Schulhof and Bossert.—Influence of the slope of refringence on astronomical refraction, by M. Glasenapp. By this term he denotes the effect of atmospheric layers of equal density not being generally distributed in concentric surfaces on the earth's surface (as they are supposed to be in all theories of astronomical refraction) He proposes to investigate the influence of this phenomenon and its law of variation; to find whether it have an annual period, and if so, of what nature, to study the influence of this on the annual parallax of fixed stars and their aberration, also to study lateral refraction.—On the contact of conics and surfaces, by M. Darboux —On a class of linear differential equations, by M Appell.—On the integration of equations with partial derivatives of the first order, by M. Collet.—On linear differential equations of the second order, by M Mittag Leffler.—Reclamation of priority on the subject of the law of corresponding boiling temperatures, by M Duhring —On radiophony (second note), by M Mercadier The sounds may be got from oxyhydrogen lamps and gas lamps without concentrating lenses, if the lamps be brought very near the (glass) interrupting wheel, and the rays limited by a diaphragm with aperture. A copper disc (0 002 m. thick) was placed near the wheel, and heated on the side opposite to that of the wheel with an oxyhydrogen blowpipe. Sounds were heard when the disk still remained invisible in the dark (though louder when the disk was raised to a dark or bright red).—On new and economic methods of producing intermittent luminous signals, by M. Mercadier. Instead of using a diaphragm with a constant source of light, he varies the source; *e g* by introducing oxygen suddenly into a low flame This is done by pressing a key, and so releasing from pressure a tube conveying the oxygen.—On the absorption-spectrum of ozone, by M. Chappuis. Eleven dark bands are observed in the visible spectrum, and several correspond with telluric bands of the solar spectrum.—Action of hydrochloric acid on metallic chlorides, by M. Ditte —Action of hydrofluoric acid on bichromate of ammonia, by M. Varenne.—On chlorised derivatives of strychnine, by MM Richet and Bouchardat They have isolated three such compounds, retaining in different degrees the chemical properties of strychnine.—On the cause of spontaneous alteration of the raw sugar of cane, by M. Gayon. He gives reasons for thinking this process a true fermentation.—On the variations of luminous sensibility according to the extent of the retinal parts excited, by M. Charpentier. One region, seventeen to eighteen hundredths of a millimetre in diameter, and corresponding to the *fovea centralis*, requires a determinate quantity of light, independent of the extent of surface, to excite it. In other parts the minimum illumination is proportional to the surface.—Anatomic researches on *Onchidium*, Cuv. (*Oncidiella celtica*, Gray), by M. Joyeux Laffine.—Serpentines of Corsica, their age and origin, by M. Dieulafait. M. Hebert dissented from some of the results in this paper.

VIENNA

Imperial Academy of Sciences, December 16.—Herr v. Burg in the chair.—Table of the most important relations of astronomy and geography, by Herr Letoschek.—Further researches on identity of the comets 1869 III. and 1880 *e*, by Herr Zelbr and Dr. Hepperger —On leucæmia, by Herr Ludwig.—Fourth report of the Prehistoric Commission, containing (1) Szombathy on this year's prehistoric investigations and excavations at Kiritein and Mokrau in Moravia; (2) Luschau on several old burial-places in Bosnia and Dalmatia; (3) Heger on skeleton graves of Tlonic, grave-mounds at Tschemin (Bohemia) and at Wassering in Lower Austria, and tumuli at Mars in Hungary.—Theoretical researches on the displacements of the radiation-points of dissolved meteor-streams, by Herr v. Riessl.—Application of hyposulphate of soda to separation of copper from cadmium, by Herr Vortmann —Some experiments on an earth-magnetic inductor, by Herr Stefan.

BERLIN

Geographical Society, December 4 —Dr. Nachtigal in the chair.—It was stated *inter alia* that Herr Flegel, who is busy in the Niger region, had gone from Lukodja to the King of Nupe or Nife, seeking letters of introduction to the rulers of the Haussa States, so as to make a safe journey up the Niger, especially on the stretch between Tawa and Sai. He had a friendly reception, and wrote in good hopes (October 10). From Sai he means to go to Sokoto, the chief town of the Haussa States, and there to get letters for the ruler of Adamaua. A large collection of ethnological objects of the Niger region is looked for in Berlin —Rumours of the death of Herr Hildebrandt in Madagascar prove false A letter from him dated Krabé in Betsileo (Central Madagascar), September 2, 1880, states that he had made a journey, rich in results, from the West Coast to the Central Plateau, but his health broke down, when he was two hours' journey from the capital, to which however he was shortly brought by Herr Cousins and tended for a time in the Norwegian mission-house till able in July to visit the hot springs of Siralé (for health). He discovered in the moor at Siralé the skeleton of an extinct species of hippopotamus —Dr Kiepert gave details of Mr. Doughty's expeditions in Central Arabia, which have cleared up much of the physical geography of that region.—Dr. Holub spoke on the Maruthameich in southern interior Africa, north of the lower, and about the middle course of the Zambesi

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THURSDAY, DECEMBER 30, 1880

PERUVIAN BARK

Peruvian Bark: a Popular Account of the Introduction of Chinchona Cultivation into British India. By Clements R. Markham, C.B., F.R.S. 1860–1880. (London: John Murray, 1880.)

"THE enterprise undertaken by me in 1859 of introducing the cultivation of Peruvian bark trees into British India and Ceylon is now an assured success." With these words Mr. Markham begins his preface, and a perusal of the convenient history he has put together of the gradual steps by which during the past twenty years this success has been reached, enables us to fully share the satisfaction with which they must have been written. Not merely has a cheap supply of febrifuge alkaloids been brought within reach of the fever-haunted population of India, but a new and highly-profitable industry has been opened to the planters of our tropical colonies, and the yield of an inestimable drug placed beyond risk of exhaustion.

Enthusiasm is in most enterprises essential to success. If a certain tinge of impracticability often accompanies it, a moderate experience of human nature disposes us to regard this with a good deal of toleration. We may as well confess at once therefore that the pleasure with which we have studied Mr. Markham's pages would have been greater but for his insistance throughout on two grievances, in neither of which do we find ourselves in any way persuaded by his advocacy. One of these—the other is more serious, and must be adverted to further on—is irritating in inverse proportion to its importance. The names of genera employed in systematic botany are Latinised forms, very arbitrary, and often, it must be allowed, unscholarly in their construction. But they are symbols or dockets under which scientific information can be arranged. If there is one thing about which botanists, of whatever nationality, are agreed, it is that the docket, having once been promulgated and brought into use, shall not be meddled with. It may be abolished or merged in some other, but being a mere symbol it cannot be tampered with without disturbing all kinds of mechanical aids to study, such as indexes and catalogues, and so adding to the worry of life. From a literary point of view the correction of *Cinchona* into *Chinchona* may be desirable, but the trouble of having two spellings in circulation is too great a price to pay for the mere satisfaction of literary propriety. It cannot be said therefore that this is merely a literary question like such spellings as those of diocess and chymistry affected by the *Times*, while from a technical point of view it has been already discussed and conclusively decided against Mr. Markham in the pages of this journal.

The genus *Cinchona*—as we must still beg leave to call it—includes all the plants at present known to yield quinine and allied alkaloids. It has rather more than thirty species, some of which however are medicinally valueless, while the rest vary individually in the amount and character of the alkaloids they yield. The native habitat of the genus is very restricted; it is only found on the Andes between 10° N. and 19° S. lat., and between 2500 and 9000 feet of elevation. Besides this the several species are closely limited to particular portions of the general area.

The native inhabitants seem to have set little store on the febrifugal properties of the cinchonas, and indeed to have been little aware of them except in the neighbourhood of Loxa, where a Jesuit was cured in 1600 of a fever at Malacotas by Peruvian bark, and to this day the local prejudice against its use is very strong. In 1638, however, the Countess of Chinchon, wife of the Viceroy of Peru, was cured of intermittent fever by bark sent by the Corregidor of Loxa. The remedy, whose reputation was now established, was carried by her to Spain in 1640, and became known as *Pulvis comitissæ*. In 1670 it was sent to Rome by the Jesuits and distributed to members of that order throughout Europe. Hence it came to be called Jesuit's bark, and it is interesting to find that its merits became accordingly a party question between Protestants and Catholics.

For more than a century (till 1776) the only bark met with in commerce was that brought from the neighbourhood of Loxa. This was called Quinquina, from the Indian name *quina-quina*, *quina* meaning bark, and the reduplication the possession of medicinal properties. The plant producing the bark was described by Linnæus under the name of *Cinchona officinalis*, to be rechristened afterwards by Humboldt and Bonpland *Cinchona condaminea*, a change correctly rejected by Mr. Markham, following Sir Joseph Hooker, and, be it remarked, on precisely the same grounds as those on which the rechristening of the genus as *Chinchona* must also be rejected.

As early as 1735 Ulloa represented to the Spanish Government that the Loxa forests could not long survive the reckless treatment to which even then they were subjected. And this was in spite of the intelligent efforts of the Jesuits, who endeavoured to enforce replanting as a religious duty. The Loxa bark, eventually distinguished as Crown bark from being reserved, when other kinds became known, for use in the Royal Pharmacy at Madrid, is represented in old collections of Materia Medica, such as that of the College of Physicians, by massive fragments which must have been detached from very old trees. Mr. Markham tells us that it is now only found in commerce in the minutest quills. As the Loxa bark became scarce the search after other supplies of cinchona bark was stimulated. The botanical expedition of Ruiz and Pavon sent by the Spanish Government in 1777 resulted in the discovery of seven species of *Cinchona*, yielding grey bark, near Huanuco in Northern Peru. Mutis, another Spanish botanist, believed that he first detected a *Cinchona* in Columbia in 1772, though a resident in Bogota challenged his claim to priority.

The well-known "red bark" of the slopes of Chimborazo seems to have been known early in the last century, and later to have found its way into European markets, though it was not till 1857 that the plant yielding it was clearly identified by Dr. Klotzsch. The yellow or Calisaya barks of Bolivia, first discovered by Haenke in 1776, did not become of commercial importance till 1820, when quinine, the most important active principle of Peruvian bark having been isolated by the French chemists, Pelletier and Caventou, yellow bark was recognised as richer in it than any other kind.

It is not necessary to follow in detail the interesting account given by Mr Markham of the recklessness with which the natural supplies of Cinchona bark were drawn upon The inconvenience of a precarious dependence upon the South American forests has for at least forty years occupied the attention of scientific men in Europe Royle, in 1839, urged the introduction of Cinchonas into India, and pointed out the Nilgiri Hills as a suitable locality The Dutch botanists had been no less urgent that the experiment should be made in Java, and Hasskarl was commissioned to proceed to Peru in 1852 to obtain seeds. In this he succeeded, but the bulk of the seeds eventually proved to belong to a species worthless medicinally, which was afterwards named *C. Pahudiana* He also obtained, by the aid of a Bolivian named Henriquez, 400 plants of the yellow bark, *C Calisaya*, only two of which unfortunately survived in Java. The mishaps of the Dutch enterprise cannot be followed here, instructive as they are to any one interested in the cultivation A happy accident, to be presently alluded to, was a kind and well-deserved turn of fortune in its favour, and a greater measure of success than could ever have been hoped for now seems assured to it

The Government of India in 1852 first proposed the introduction of cinchona into that country, and several abortive attempts to effect it were made with the aid of the Foreign Office, but without success In 1859 Mr Markham was officially employed by the present Lord Derby, who was then Secretary of State for India, to undertake a mission to South America for the purpose His previous travels in the Cinchona region, though for ethnological and not for botanical inquiry, and his knowledge of the Spanish and Quichua languages singularly fitted him for the task The plan laid down by him was extremely comprehensive, and has at last been fully carried out, or nearly so It was nothing less than the introduction into India of all the species of *Cinchona* yielding bark of known commercial value This plan was adopted as it was *à priori* uncertain which kinds would turn out best adapted for Indian cultivation, and it was desirable that all should be tried, it involved no less than five distinct expeditions to the different districts of the Andes already mentioned.

Mr Markham visited himself in 1860 the yellow bark region in Southern Peru and Bolivia, accompanied by a young gardener named John Weir, recommended by Messrs Veitch The plants collected reached England in fifteen Wardian cases, but the heat of the Red Sea was fatal to them and they all eventually died A supply of seed which Mr Markham had arranged for at Caravaya arrived in India in 1865 and germinated satisfactorily

Mr Pritchett, who had travelled in the Huanuco district, was employed to make a collection of the grey bark plants, and to these also the Red Sea was fatal, but the loss again was retrieved by the safe transmission to India of seed which grew well The red bark region was visited, at the suggestion of Sir William Hooker, by the well-known botanical traveller, Dr Spruce, who was residing in South America at the time, and he was accompanied by Robert Cross, a Scotch gardener, recommended by the Kew authorities. The plants collected by Dr Spruce were more fortunate, and reached India in good condition in 1861 under Mr. Cross's charge. This skilful collector then returned to South America and obtained the seed of the crown bark from the Loxa forests, which reached India in 1862 and germinated abundantly Before returning to Europe he visited the Columbian forests in 1863 and secured seed of Pitayo bark (*C. Pitayensis*), which however had lost its vitality before it arrived in India He was therefore sent again in 1868, and this time secured both plants and seeds, which were transmitted to India in a living state The only remaining kinds of importance which had not been introduced into India were the Calisaya de Santa Fé, yielding soft Columbian bark, and *Cinchona cordifolia*, yielding hard Carthagena bark, to procure these Mr Cross was despatched on another mission, from which he returned in 1878, bringing cuttings of both kinds, and these were successfully propagated at Kew, which had indeed in every case been made the depôt for the receipt of the successive consignments and their despatch to India The Carthagena bark is now well established in India, Jamaica, and it is hoped in Ceylon But the fate of the Calisaya de Santa Fé is still doubtful, as one consignment succumbed to the heat of the Red Sea, which is so great an obstacle to the transport of plants, intolerant of great heat, and no news as to the second instalment taken out in charge of Mr Cross has yet reached this country

We must but very briefly hurry over the interesting pages in which Mr Markham describes what has been done in India Red bark has everywhere taken the lead Next to this, in the Nilgiris, crown bark has succeeded best, the other kinds have made but little progress Unfortunately little care seems of late to have been taken in Southern India to keep the different kinds distinct, and as the species hybridise very freely it is not easy to say what some of the plants actually in cultivation precisely are. In the Himalayas, however, besides red and crown bark-plants, *C. Calisaya* (yellow bark) and *C micrantha* (one of the species yielding grey bark) also do well

The share taken by Kew in this important enterprise enabled the advantages secured by the Indian Government to be extended to other tropical possessions in the Empire Sir William Hooker was allowed to transmit a share of the seeds and plants to Ceylon, Jamaica, Trinidad, Mauritius, and St Helena In the three latter islands the cultivation has made but little progress, in the first it is now one of the staple resources of the planters, while in Jamaica the crown and red bark bring in an annual revenue to the Government, which leaves an ample surplus after paying the whole expenses of the botanical department

One of the most singular incidents in the whole story has still to be told Mr Charles Ledger, who had long resided in South America, hearing of Mr. Markham's enterprise, employed a native servant, Manuel Mamani, to collect seed of the best Calisaya or yellow bark tree Four years elapsed before he succeeded, as each year the blossom of the trees was destroyed by frost These seeds were transmitted to London to the care of Mr. Ledger's brother, and it is believed were offered to the Indian Government, who refused to purchase them. Half was eventually sold to the Dutch Government and half to Mr. Money, a planter on the Nilgiris. This fortunate purchase has put quite a

new face upon the cultivation in Java The bark of some of the trees has yielded as much as 10 per cent of quinine; and the news of this remarkable result has produced much the same effect on Cinchona planters in Ceylon and Southern India as the discovery of a gold-field on the inhabitants of an Australian city The Java officials have however behaved with singular liberality in the matter, and in the course of a few years it cannot be doubted that Ceylon will be abundantly supplied with this valuable kind, which, there seems reason to think, may prove to be a distinct species Part of the seed sent in the first instance to the Nilgiris seems to have found its way to Sikkim, and the Government plantations there are believed to be in possession of a strain of Calisaya, little if at all inferior to that possessed by the Dutch.

The Government of Bengal have effected an enormous saving by using, in hospitals and dispensaries, instead of quinine imported from Europe, the febrifuge manufactured at the Sikkim plantations The Government estimated that in consequence, by the end of 1879, "the plantations will have cleared off the entire capital that has been invested in them"

And this leads us to what is really the painful feature in Mr. Markham's book. He complains in repeated and in bitter terms of the want of justice which has been shown to those whom he employed in the business of collecting "Those who did the work have not received fair recompense for most valuable services" It is rather singular to find that he adduces in support of this statement the case of Mr Ledger, who was not even in any way commissioned to do what he did But the remuneration which his actual agents received was the ground of no complaint on their part, and was in point of fact liberal compared with that which is given to the collectors who are constantly employed by the great nurserymen, and who too often lose their lives in their arduous pursuits without the satisfaction of feeling that they are doing so in an enterprise like this of lasting utility But we fear that if Mr Markham's assistants have reason to complain the blame must, on his own showing, be laid at his own door He tells us (p 271) "The system I adopted was to include very slight remuneration in the original agreements. *Thus the loss to Government would be insignificant if the work was not executed satisfactorily* If, on the other hand, the arduous tasks were successfully performed . I anticipated no difficulty in obtaining fitting recognition for such distinguished services" We leave our readers to judge of the probability of such a scheme answering Mr Markham's expectations. We may go further, and ask how the claims would have stood if, notwithstanding all the pains that were taken, the cultivation of Cinchonas had fared in India—as might even have happened—no better than it at first did in Java.

But there are many other things pleasanter than this which we should like to touch upon if this review had not already run to an inordinate length. So many Englishmen are now in one way or other interested in colonial industries that it will be strange if this interesting book does not find as many readers as it deserves. Besides a complete history of the Cinchona enterprise in the Old World, it gives, in an appendix, accounts of some other South American vegetable products, notably india-rubber. The steps taken at Mr Markham's instance for the introduction into India of the most important rubber-yielding plants of the New World have been from time to time recorded in our pages We have only to repair one inadvertent omission on Mr Markham's part, and point out that the transmission of the Para rubber plant to India was secured by the exertions of Mr Wickham, as recorded in the Kew Report for 1876, p 8

PRACTICAL BLOWPIPE ASSAYING

Practical Blowpipe Assaying By George Attwood. With Seventy-four Woodcuts (London: Sampson Low, Marston, Searle, and Rivington, 1880)

THIS book shows many signs of carelessness on the part of the author At the very outset, in the Introduction, we meet with strange statements Mr Attwood divides the elements into those which are of commercial value and those which are of no commercial value In the latter class we find Uranium and Tungsten, surely the author does not intend to deny the value of pitchblende and wolfram He classifies zirconium among the non-metallic elements.

The first part of the work describes the reagents and apparatus, the second, we are told, contains the modes of determining any one of the sixty-four well-recognised elements, and in the third part we have the methods adopted by the author for making quantitative assays by the blowpipe Finally, Part IV. contains some tables showing the English and American values of gold according to its fineness, and the value of gold coins in the United States

The apparatus employed is much the same as that recommended by Plattner Like Neumann, Mr Attwood very wisely uses riders with his balance instead of the very small weights supplied by some of the other Freiberg opticians, but the balance would be improved by the addition of a movable arm for shifting these riders The steelyard devised by the author will probably be of use to explorers From practical experience with the batea I can fully endorse all that is said in its favour, but why are the merits of the iron pan ignored? It has the advantage that it will stand rougher usage than the batea Again, for washing a sample of tin ore nothing will beat the Cornish vanning shovel

I regret to see no mention of the useful little pastilles and crucibles made out of charcoal powder, proposed by Griffin thirty or forty years ago and adopted by Plattner Col. Ross's aluminium plate for sublimates seems also to have escaped Mr Attwood's notice.

With reference to the list of reagents I must remark that the author does not name all the reagents which his tests require, whilst others are inserted which he does not appear to put to any use I should be glad to know what he means by inserting "nitrous acid" among his reagents. This is not a misprint for "nitric acid," because that acid has been already named

The plan of the second part of the work is not one which I should recommend. It simply contains a list of tests for the various elements, but gives no systematic scheme for making the examination of an unknown substance. I fear that the "direct" method advocated by Mr. Attwood will often prove a very tedious one Many of the tests themselves are not so complete as they

ought to be In describing the tests for barium it is said that the bead "can be flamed," but no explanation is given of the process of flaming The capital test for bismuth with potassium iodide and sulphur is entirely ignored

I now come to the third part, which treats of quantitative assays. Mr Attwood's plan of making a check assay in every case with a small quantity of the pure metal is certainly calculated to give the operator confidence in his results The author adopts $1\frac{1}{2}$ grain as the amount of ore to be taken for an assay. I think he would have done better to have followed Plattner and used the French weights, because there is less chance of making errors where each milligramme means 1 per cent

For the silver assay Mr. Attwood employs pieces of ordinary charcoal instead of the far more convenient and portable charcoal crucibles designed by Plattner He also describes a crucible assay for silver ores, which does not appear to possess any advantage over Plattner's scorification method

There is one most unfortunate error in the book to which I feel bound to call attention. Mr Attwood gives some tables for calculating the number of ounces of gold or silver per ton from the results of assays of $1\frac{1}{2}$ grain of the ore In an unlucky moment he forgot that gold and silver are weighed by *troy* weight, and calculated his tables for *avoirdupois* ounces. The consequence is that these tables are not only valueless, but also highly misleading Let us take one case as an example Suppose that $1\frac{1}{2}$ grain of ore had yielded 0·01 grain of fine metal We look down the table (p 117), and find, according to Mr. Attwood, that the yield would be 238·93 oz per ton, in reality the yield should be 217·77 oz

Some neat little retorts have been designed by the author for distilling ores of mercury and amalgam, but he does not mention Kustel's assay

On coming to the tin assay we have the peculiar statement that silica may be separated from tin ore by boiling it with hydrochloric acid "The assay being finely powdered, the silica is dissolved." "The dissolved silica is decanted off" (p 158). Cornish mine agents will be surprised when they are told that, in order to obtain correct-results, it is necessary to wash or van as much as *5 lbs.* of an ordinary tin ore (p 159)

Under the head of nickel no mention is made of the valuable ores from New Caledonia.

Small mistakes are numerous The size of a box is said to be "twelve inches square" (p 3), we note also "*a* most useful addend*a*" (p 24), "chloride of ammoni*a*" (p. 33), "manganite" instead of manganate (p 53), and permanganate (p. 54) The term "raw iron" is used frequently instead of "pig iron," and shows that the author has copied Cornwall's translation blindly. Coal, anthracite, and graphite are said to "volatilise" when heated in the platinum spoon (p 82) Sieves are made with 2000 holes per "linear" inch (pp 100 and 137). In the description of cupellation (p 106) we read, "The lead parts with portions of its oxygen to the copper and other base metals."

In conclusion I think that the value of the book would be increased if a list of *errata et corrigenda* were inserted, correcting some of the errors which, I regret to say, impair its general usefulness. C. LE NEVE FOSTER

OUR BOOK SHELF

Uber die von den Trichopterenlarven der Provinz Santa Catharina verfertigen Gehause. Von Dr. Fritz Muller. *Archivos de Museu national.* Vol iii pp. 99-134, and 209-214. Rio de Janeiro, 1880. (Aus dem Portugieischen ubersetzt von dem Bruder des Verfassers, Dr. Hermann Muller in Lippstadt)

DR FRITZ MULLER has for some years been engaged upon an investigation of the habits of the Caddis-flies of Santa Catharina, and has shown extraordinary skill in breeding these insects, a matter always difficult, and especially in the case of those that inhabit running water The results of his researches were foreshadowed in various notes published in the *Zoologischer Anzeiger* and in the *Transactions* of the Entomological Society of London for 1879 But it was well known that the extended information and figures would be given in the Rio de Janeiro *Archivos* As this publication is somewhat difficult to obtain, and as most of us are not familiar with Portuguese, Dr Hermann Muller has conferred a great boon by publishing a translation of the paper (accompanied by the two folded plates) in the *Zeitschrift fur wissenschaftliche Zoologie* for the present year (pp 47-87, plates iv and v.). It is needless to state that the details are of the greatest interest, and we have here the most important contribution to the natural history of *Trichoptera* that has appeared since the publication of Pictet's "Recherches" on the species of Geneva, and worked out in a far superior manner. We cannot here even allude to most of the many marvels of insect-architecture and habits that Dr Fritz Muller has revealed. Some of the most interesting are the numerous forms of *Helicopsyche*, which build little sand-cases so like shells that they have been described as such, those *Dentalium*-like cases, originally noticed by Aug. St Hilaire as *Grumicha*, which name our author retains, those instances of parasitism (or worse) in which a larva of one species dispossesses that of another of its house and converts it to its own purposes, those very numerous forms of *Hydroptilida*, the most minute of all *Trichoptera*, with cases of the most varied and wonderful structure, above all, that most interesting fact that the rain-water which collects at the bases of the leaves of some *Bromeliaceae* has a special fauna of its own, including at least one Caddis-worm The descriptions of these and many others will be read with delight by every biological student, and we hope Dr Muller will follow up the paper by records of further discoveries, for here, as in all his works, the evidences of superior powers of observation strike one on every page

The plates are excellent, and aid much in a realisation of the descriptive portion Dr Muller's artistic powers are so marked that we cannot but regret he has not furnished details of the form and structure of the perfect insects also, which would have greatly aided systematists; in fact the perfect insects are only alluded to in a casual manner

Voyages of the Elizabethan Seamen to America Thirteen Original Narratives from the Collection of Hakluyt, Selected and Edited, with Historical Notices, by E J. Payne, M.A. (London. De La Rue and Co, 1880)

WE do not quite understand Mr Payne's reason for publishing this selection from Hakluyt's classical collection of voyages The selection is, however, judicious, and cannot fail to be interesting, and at the same time instructive, to those who desire to become familiar with the first beginnings of English conquest in America Mr. Payne's familiarity with the subject of British colonisation, as exemplified in his excellent little "History of European Colonies," specially qualifies him for making such a selection as the present. His brief Historical Introduction enables the reader to understand the special significance of the voyages contained in this volume. He

shows the various causes in operation at the time to instigate such voyages, causes mainly political and commercial. Other influences were however at work, not the least of which was "the total transformation which astronomy and geography had undergone" during the sixteenth century. The narratives here given are those of Hawkins's and Frobisher's three voyages, Drake's voyages of 1577 and 1585, Gilbert's voyage of 1583, Amadas and Barlow's voyage, 1584, Cavendish's first and last voyages, and Raleigh's voyage to Guiana. Prefixed to each narrative is a short historical introduction.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.

The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Black Sheep

THE following extract of a letter from Mr. Sanderson of Chislehurst, who permits me to publish it, seems worth placing on record. It relates to the former frequent appearance of spotted or black sheep in the Australian flocks, as long as animals thus coloured were of use to man, although they were never, as far as Mr. Sanderson knows, separately bred from, and certainly not in his own case. On the other hand, as soon as coloured sheep ceased to be of use they were no longer allowed to grow up, and their numbers rapidly decreased. I have elsewhere assigned reasons for the belief that the occasional appearance of dark-coloured or piebald sheep is due to reversion to the primeval colouring of the species. This tendency to reversion appears to be almost difficult quite to eradicate, and quickly to gain in strength if there is no selection. Mr. Sanderson writes:—"In the early days before fences were erected and when shepherds had charge of very large flocks (occasionally 4000 or 5000) it was important to have a few sheep easily noticed amongst the rest; and hence the value of a certain number of black or partly black sheep, so that coloured lambs were then carefully preserved. It was easy to count ten or a dozen such sheep in a flock, and when one was missing it was pretty safe to conclude that a good many had strayed with it, so that the shepherd really kept count of his flock by counting his speckled sheep. As fences were erected the flocks were made smaller, and the necessity for having these spotted sheep passed away. Their wool also being of small value the practice soon grew of killing them off as lambs, or so young that they had small chance of breeding, and it surprised me how at the end of my sheep farming experience of about eight years the percentage of coloured lambs produced was so much smaller than at the beginning. As the quantity of coloured wool from Australia seems to have much diminished, the above experience would appear to be general."

CHARLES DARWIN

The Nature of the Chemical Elements

DR. ARMSTRONG'S article in NATURE, vol. xxiii. p. 141, has brought to my mind some calculations I made more than a year ago to test a theory I had long previously entertained. Most of us who have paid much attention to the subject are agreed that the elements are capable, under exceptional circumstances, of profound chemical change. Mr. Lockyer is searching, with success as it appears, for contemporary evidence of this by examining the condition of the solar surface. The other line of evidence is historical, and turns mainly on the classification of the numerical values of chemical symbols. It is of course only with the latter that I have to deal.

The classifications proposed by Newlands and Mendelejeff are comprehensions of much similar preceding work. They appear to me to be faulty in two ways: (1) on account of the seriously large number of elements they wholly fail to include, and (2) because of the strong stress they lay upon arithmetical series of a rough *per saltum* character. As I do not know of any real case of *per saltum* chemical change, I do not think the elements should be classified on such a basis. What is wanted is a system capable of including—with exactness and not mere approximation—the whole of the elementary numbers, that system to be represented in the mathematical symbols of ordinary chemical change, and therefore free from a *per saltum* character. I have to a great extent succeeded in finding such a system, and the results of testing it at many points are as follow:—1. There is probably only one fundamental form of matter, and this, as has been previously supposed, yields our ordinary elements and many others by ordinary polymerisation. 2. Almost all the elementary numbers have been tried, and, with the exception of H and Cl, which are a little troublesome, they fall into order very exactly. 3. This order exhibits no discontinuity, and is similar to a case of ordinary chemical change. 4. There is clearly an upper limit to this order, in other words, elementary numbers of more than a certain magnitude appear to be impossible.

Sir B. C. Brodie's method is really a classificatory one; and I with others had been very desirous to read the Third Part of the Calculus, in which it was promised ampler play. It will be a matter for much regret if his premature death should have prevented this. But what he did publish was sound and sure: the first real symbols chemistry has yet enjoyed, and the only ones hitherto proposed whereby the process and the results of chemical change admit of unitary as well as kinetical representation.

EDMUND J. MILLS

Smokeless London

As I hope soon to have an opportunity of reading a paper on this subject before a scientific audience I need not occupy your valuable space by replying to your correspondents of last week in detail. I may say however that the scheme has been carried out in practice at a gas-work to which I shall afterwards refer. When it was found that the apparatus for making gas on an extraction of six hours was insufficient for supplying the wants of the long winter evenings the distillation was stopped when gas had been removed to the extent of 5000 cubic feet per ton. The larger quantities obtained from the coal per unit of time and the superior illuminating power obtained per unit of volume tided over the difficulty and rendered the existing plant sufficient. No practical obstacles were discovered in discharging the retorts. I do not think the difference between an extraction of 5000 and 3333 cubic feet per ton would make a material change in this respect. Mr. Mattieu Williams points out a much more serious obstruction in the plethoric indifference of the gas companies. In reply to E. R. F., I may say that the fuel resulting from a uniform extraction of 3333 cubic feet per ton is practically smokeless if it is taken hot from the retorts and immediately quenched with water.

Westminster, December 27 W. D. SCOTT-MONCRIEFF

Colliery Explosions and Coal-Dust

ACCEPTING Mr. Galloway's view that in many mines the extent and destructiveness of colliery explosions are due to the distribution of coal dust in the air, may I suggest the possibility of preventing the explosion from spreading beyond the sphere of the fire-damp by sprinkling the floors throughout, at certain regular intervals, with mineral oil? A shady road, with one such sprinkling, may be kept free from dust for several weeks during the summer, and the corridors of a mine, not being open to wind and rain, would of course remain wet for a longer period. A saucer filled with dust and treated with mineral oil will retain the oil for months even when exposed to sun and rain. The mixture of coal dust and oil is quite uninflammable. The experiment may perhaps be worth trying in one of the drier coal-mines.

December 27 R. RUSSELL

Geological Climates

PROF. DUNCAN is under the impression that the claim of *Araucaria Cunninghami* to have flourished at Bournemouth during the Eocene, rests on "a bit of a leafy part of a tree," and that this bit is "squashed." The foliage is however abundant there, occurring almost wherever vegetable remains are found, from the east of Bournemouth Pier to half a mile beyond Boscombe. In one place, where a bluff is literally full of it, the disarticulated branchlets are perfect, and not in the least degree compressed. Again, the determination was not made by Prof. Haughton, but rests upon my statement that this foliage and that of *A. Cunninghami* cannot be distinguished one from the other. That it is Araucarian foliage I am perfectly satisfied, but whether the existing Australian species is identical and unmodified, must remain doubtful until other

organs besides foliage are found, it being by no means absolutely certain that because the foliage is identical the species are so. The discussion raised by Prof. Haughton, and continued by Prof. Duncan and Mr Wallace, seems therefore hardly worth prolonging, since it is based upon an assumption that is only probably correct. But even if the identity were proved, a single species is not satisfactory evidence of former temperature

I am indebted to Mr Winslow Jones for the only information that I have yet obtained about the growth of either species in England. He recollects a small tree of *A excelsa*, growing near the water's edge in a garden on the upper portion of Falmouth Harbour, which he believes died three years ago. He has seen *flourishing trees* at Naples, Cintra, Malta, and Algiers, but even Northern Italy seems beyond the range of successful cultivation. Of the two *A Cunninghami* seems the more tender, though possibly its less symmetric growth may have excluded it from many gardens In Madeira it grows generally best close to the sea and in sheltered places.

Lindley was mistaken in regarding the two species as one. All the needle-leaved (Eutacta) section of Araucaria are certainly closely allied, for the species, however distinct in other respects, possess two kinds of foliage, that of the young plants being identical in all yet otherwise the species are clearly and distinctly marked off from each other.

With further regard to the identification of the Bournemouth foliage with Araucaria, I find that Massalongo[1] gives an excellent photograph of the same foliage from Chiavon, in North Italy, and of an immature cone consisting of 250 scales Although existing Sequoias have cones with from 16 to 20 scales, Schimper says "Il est sans aucun doute un *Sequoia* et peut être identique au *S. Sternbergii*. Les cônes ont la plus grande ressemblance avec ceux du *S gigantea*" (Pal. Végétale," vol III. p 573). I am beginning to lose all faith in the so-called science of palæo-botany as worked out by our Teutonic brethren Not only is the above quotation an absurdity, for which Heer is responsible, but I fail to see any good evidence to support the change made by Heer from *Araucaria*[2] *Sternbergii* to *Sequoia Sternbergii*. The foliage is more Araucaria like than Sequoia-like, and has been found associated with an Araucaria cone, but never with any Sequoia cones It has nothing to do with the Icelandic foliage, neither with the Upper Miocene foliage from Turin, nor that from Bilin nor Oeningen. The true *Araucaria Sternbergii* characterises a well-marked horizon, that of the Newer Eocene or Oligocene in Central Europe, and has been found at Barton in Hampshire, it differs from the Middle Eocene form (*A venetus*, Mass) of England and Italy in the needle-like leaves hugging more closely to the branchlet, as the latter differs in its turn from the Araucaria of the Grès du Soissonnais, which has needles very widely opened out This progressive change may have taken place *pari passu* with the changing climate At Sheppey, where foliage is plentiful, I have met with a beautifully-preserved axis of an Araucaria cone with the basal scales attached, exactly as we find them in the existing species

Now with regard to Mr. Wallace's letter, I pointed out in NATURE, vol xix p 126, that the Tertiary fossil plants, even of the Eocene, require at most an increase in temperature of 20°, and that the land connection between Europe, Greenland, and America, which there is reason to suppose existed then, would, by shutting out Arctic currents, have produced more than the required increment If this theory appeared for the first time in my article, however clumsily I may have worded it, and if it has been of use to Mr Wallace, it is only fair that the fact should be acknowledged, while if it has escaped his notice he will perhaps pardon my now drawing his attention to it At the same time the publication of the Tertiary flora of North-East Siberia, which I had not then seen, and of Saghalien, has modified the views I put forward in a manner which I trust I may shortly find time to explain.

J. STARKIE GARDNER

Chalk

MR. WALLACE's theory that chalk was deposited in comparatively shallow water requires careful examination before it is accepted by geologists I do not think he has given sufficient evidence to bear out his views which are necessary to his theory of continents.

Mr Wallace cites the resemblance between chalk and Globigerina-ooze, namely—

The similarity of the minute organisms found to compose a considerable portion of both deposits; several species of Globigerina appearing to be identical in the chalk and the modern Atlantic mud; the presence of Coccoliths and Discoliths in both formations, the abundance of Sponges in both; the presence of *Porifera vitrea*, the nearest representative of the Ventriculites of the white chalk, the resemblance of the forms of Echinoderms, and without attempting to reconcile these with a shallow sea-deposit, he proceeds to state the case on the other side. This consists of the difference in analysis between chalk and Globigerina-ooze, the former containing more carbonate of lime and less alumina, the presence of silica in the Globigerina-ooze being perhaps counterbalanced by the flints in the chalk. The greater proportion of alumina certainly points to different conditions, which Mr. Wallace considers to be that chalk is the very fine mud produced by the disintegration of coral-reefs, and mentions a deposit resembling chalk at Oahu in the Sandwich Islands and the deposit in several growing reefs, without however attempting to show that there is any probability that the remains found in these would bear any resemblance to the Sponges and Echinoderms of the chalk, or why we find no remains of these Cretaceous coral-reefs.

Mr. Wallace does not state in what the greater resemblance between chalk and Globigerina-ooze of shallow over deep water consists, but he looks on it as "weighty evidence."

Mr. Gwyn Jeffries, he says, finds all the Mollusca of the chalk to be shallow-water forms, many living at forty to fifty fathoms, some confined to still shallower waters, while deep sea forms are absent. The late Dr. S P Woodward considered that Ammonites probably lived in water not over thirty fathoms; and these facts are as difficult to reconcile with Mr Wallace's views that chalk was deposited in a sea of not over a few thousand feet as in a deeper sea.

The rareness of corals and absence of coralline beds of the age of the Lower or Upper Chalk is an important objection to the theory that chalk was deposited similarly to the Oahu chalk, the beds of Maestricht and Faxoe being above the chalk, and the former are not even conformable with it

The point I think is still an open one, whether we shall accept Mr. Wallace's views that chalk was deposited in a comparatively shallow sea and not very far from land, or in a deep sea, the immense break between the chalk and Eocene beds giving ample time for very considerable alteration to have taken place in the disposition of land in the interval. I send this letter in the hope that a discussion on the point may elicit new facts bearing on the subject.

S. N CARVALHO, JUN.

8, Inverness Terrace, Kensington Gardens, W.

On Estimating the Height of Clouds by Photography and the Stereoscope

THE great practical value of meteorological science and the desirability of extending its usefulness by the collection of data relating to atmospheric current will perhaps be sufficient excuse for asking attention to anything likely to promote this end.

In studying the currents and other peculiarities of the atmosphere a method of estimating the height, motion, and character, as also the position with respect to each other, of each stratum of cloud, is a requirement of almost paramount importance, the value of the means employed being proportional to the number of particulars provided in its record, and the facility with which any set of observations can be compared to another at any future period. With such ever-changing subjects as clouds in constant motion, and having no strongly-defined marks, the use of theodolites is almost out of the question, and the sextant and mirror process for similar reasons would be a very tedious operation.

These considerations have induced me to endeavour to make use of photography and the stereoscope, the former to secure a couple of simultaneously-exposed photographs at the extremities of a base line, and the latter to observe them reproduced apparently solid for the respective distances of the points composing the picture to be measured when superimposed on a scale of distances and placed in it. The base line is thus practically reduced to the width of the eyes, and the difficulties arising from motion eliminated

The recording apparatus consists of a base 50 or 100 feet long, constructed of wood and turning on a pivot at the centre of its length, its extremities being suitably supported by a framework of wood or other material upon which they could easily roll. The small cameras for the ends of this are each to be hinged at the back of its base to a second board having a graduated quadrant and rackwork erected from one of its sides for adjusting

[1] "Specimen photographicum" Verona, 1859 Plate xxi

[2] Actually described as Araucarites, a useless modification in this instance.

the camera to any degree of altitude. These supplementary boards are then pivoted at the centre of part of a divided circle, previously inlaid in the wood at the extremities of the base line, in such a manner that a line passing through the axis of the lenses would cut the pivots. The cameras thus furnished can be adjusted with ease to any vertical or horizontal angle. These angular adjustments of the two instruments must always coincide, with the slight exception that the horizontal ones must make internal angles with the base included between them, or, in other words, the lenses of both require to be directed to a point opposite to the centre of the base line.

The cameras also require their rapid exposing shutters to be electrically connected, to ensure the pair of sensitive plates being impressed at the same instant, and each dark slide employed to have a fine wire strained at its centre from top to bottom immediately in front of the prepared plate, and as close as possible to it without touching. The transparent lines produced in the developed negatives by these wires will constitute the zero of distance of any pair, and during the operation of reading off must be made to agree with similar ones on the scale of measurements obtained as follows:—

Upon a large cardboard rule a number of squares in fine black lines, one inside the other, and each one slightly out of the centre of its predecessor to the right hand, the outside square being then divided with a line at a tenth part of its diameter to the left of its centre. This line will indicate the zero of the scale. After placing a distinguishing mark or number in the corner of every square for purposes of identification, the cardboard will be ready to be photographed and reduced at the same time to the intended size of the cloud negatives. Two transparent positives copied from this and observed when placed side by side in a suitable stereoscope with the edges representing the left-hand one of the cardboard together, will appear in that instrument with the lines composing the zero only a few inches away, and the squares as a succession of vertical planes commencing some distance from that and receding from the eye in the order of greater to less, each one representing its own distance in space.

To find the value of these distances it will be necessary to focus the two cameras upon some terrestrial objects whose distances can be measured by any of the known methods, and negatives taken. The two resulting landscapes, when placed in the stereoscope, each superimposed face to face upon its respective scale, and the fine vertical lines of the whole made to occupy one apparent distance, an operation offering but little difficulty, every object or point of the landscape will be found to stand out in the vertical plane suited to its own distance, the relation between them being noted for the values found by measurement of the one to be marked upon the other. As a scale prepared thus would be of no value for any other angle at which the cameras might be placed, it would be most convenient to make use of two or three angles only, more being quite unnecessary, and prepare a scale for each, or one with a reference table of values for the respective angles would suffice. Again, in respect of altitudes: As the terrestrial measurements would only be absolutely accurate for those of clouds in the zenith, or of them, if it were possible, from the earth's centre in any direction, the tables of reference would have to include calculated corrections for altitude, or the graduations could be valued for the most useful degrees by experimental means.

It will be gathered from the above that the constancy of length of the base line can be ascertained, and corrected if necessary, by taking a couple of views of the same landscape for comparison with the preceding pair; slight fluctuations of length would not however be of much consequence in dealing with the comparatively coarse measurements of thick masses of cloud floating in so short a distance as the few miles of atmosphere capable of forming them consists.

To ascertain the height of clouds photograph a pair of negatives, and place these in the stereoscope with a pair of scale plates agreeing with the angle at which they were taken, and adjust as for the landscapes described above. The data required may then be read off by noting the vertical plane each stratum occupies.

Prints of these negatives should afterwards be made for the particulars of height, direction of motion of the respective layers, point of compass, wind rate, state of barometer, thermometer, and general remarks upon the weather, to be recorded upon them for comparison or circulation.

Meteorological observatories fitted with such an addition to their present splendid collection of instruments would have their powers of dealing with the atmosphere and weather changes greatly reinforced JOHN HARMER

Wick, near Arundel

Correction of an Error in "Island Life"

MY friend Dr. Gunther has kindly called my attention to an extraordinary error at p. 322–323 of my "Island Life," where I state that the Loch Killin Charr (*Salmo Killinensis*) inhabits a lake in Mayo County, Ireland, instead of a small lake in Inverness-shire, 2000 feet above the level of the sea, as given in Dr. Gunther's original description in the *Proceedings* of the Zoological Society, 1865, p. 698. On referring to my MSS. notes for this part of my work, I find that the habitat was first correctly given, but subsequently scored out and altered to the erroneous Irish locality! Why this was done I cannot now discover, and I can only regret that I should have fallen into so palpable an error, and request such of the readers of NATURE as possess my book to make the necessary alterations.

ALFRED R. WALLACE

Natural Science for Women

WILL you allow me to supplement your kindly reference to the instruction in physical science given to women in Bedford College, London, by the statements that for the last two sessions a class in biology has been conducted there by Mr. Charles Stewart of St. Thomas's Hospital Medical School. The course of study is in every sense a practical one, with special reference to the Preliminary Scientific and First B.Sc. examinations at the University of London, and the best testimonial to the excellence of the instruction in these various subjects is furnished by the remarkable success during the present year of the Bedford College pupils at the University examinations, a success not less marked in the Science than in the Arts examinations.

ALFRED W. BENNETT

Movements of Leaves

A YEAR ago we had in our conservatory a healthy young plant of *Acacia mollissima*. It bore no flowers, but consisted of a simple axis adorned with the soft feathery leaves of its genus, which closed up at night. Our gardener however thought it would improve in appearance if it could be made to bear a few branches, and with that view he cut it back. His end was achieved: a new stem shot up from the section, and graceful limbs were thrown out in turn by it. But along with this a strange result followed: the fresh leaves borne by the new stem and by the branches now closed at night, while the old leaves below the section ceased to do so. These lower leaves have long since fallen off, but the upper ones kept to their habit, and at the present time all fold up at dusk save a few of the very oldest, which only partially shut, or, in one case, do not shut at all. When our plant was cut back it stood three feet high, now it stands seven: which shows that the vigour of the plant as a whole in no wise diminished by the operation.

Chislehurst, December 23 M. L. ROUSE

ON DUST, FOGS, AND CLOUDS[1]

DUST, fogs, and clouds seem to have but little connection with each other, and we might think they could be better treated of under two separate and distinct heads. Yet I think we shall presently see that they are more closely related than might at first sight appear, and that dust is the germ of which fogs and clouds are the developed phenomena.

This was illustrated by an experiment in which steam was mixed with air in two large glass receivers; the one receiver was filled with common air, the other with air which had been carefully passed through a cotton-wool filter and all dust removed from it. In the unfiltered air the steam gave the usual and well-known cloudy form of condensation, while in the filtered air no cloudiness whatever appeared. The air remained supersaturated and perfectly transparent.

The difference in the behaviour of the steam in these two cases was explained by corresponding phenomena,

[1] Abstract of a paper read to the Royal Society of Edinburgh, December 20, by Mr. John Aitken. Furnished to NATURE by the Council of the Society.

in freezing, melting, and boiling. It was shown that particles of water vapour do not combine with each other to form a cloud-particle, but the vapour must have some solid or liquid body on which to condense Vapour in pure air therefore remains uncondensed or super-saturated, while dust-particles in ordinary air form the nuclei on which the vapour condenses and forms fog or cloud-particles

This represents an extremely dusty condition of the air, as every fog and cloud-particle was formerly represented by a dust-particle, which vapour by condensing upon it has made visible When there is much dust in the air but little vapour condenses on each particle, and they become but little heavier, and easily float in the air If there are few dust specks each gets more vapour, is heavier, and falls more quickly

These experiments were repeated with an air-pump, a little water being placed in the receiver to saturate the air The air was then cooled by slightly reducing the pressure. When this is done with unfiltered air a dense cloudiness fills the receiver, but when with pure air no fogging whatever takes place, there being no nuclei on which the condensation can take place In this experiment, and in the one with steam, the number of cloud-particles is always in proportion to the dust present When the air is nearly pure and only a few dust-particles present, then only a few cloud-particles form, and they are heavy and fall like fine rain.

The conclusions drawn from these experiments are (1) that whenever water vapour condenses in the atmosphere it always does so on some solid nucleus, (2) that dust-particles in the air form the nuclei on which the vapour condenses, (3) that if there was no dust there would be no fogs, no clouds, no mists, and probably no rain, and that the supersaturated air would convert every object on the surface of the earth into a condenser on which it would deposit, (4) our breath when it becomes visible on a cold morning, and every puff of steam as it escapes into the air, show the impure and dusty condition of our atmosphere

The source of the fine atmospheric dust was then referred to, and it was shown that anything that broke up matter into minute parts would contribute a share The spray from the ocean, when dried and converted into fine dust, was shown to be an important source Meteoric matter also probably contributed a proportion Attention was then directed to the power of heat and combustion as a source of this fine dust.

It was shown that if there is much dust then each particle only gets a little vapour condensed upon it, that when the particles are numerous they become but little heavier, and easily float in the air, and give rise to that close-packed but light form of condensation which constitutes a fog, and therefore whatever increases the amount of dust in the air tends to increase fogs, and that when the dust-particles are not so numerous the cloud-particles are larger and settle down more quickly.

It was shown that by simply heating any substance, such as a piece of glass, iron, brass, &c, a cloud of dust was driven off, which, when carried along with pure air into the experimental receiver, gave rise to a dense fog when mixed with steam So delicate is this test for dust that if we heat the one-hundredth of a grain of iron wire the dust driven off from it will give a distinct cloudiness in the experimental receiver, and if we take the wire out of the apparatus and so much as touch it with our fingers and again replace it, it will again be active as a cloud-producer. Many different substances were tried, and all were found to be active fog-producers. Common salt is perhaps one of the most active

Heat, it is well known, destroys the motes in the air, and it might be thought that flame and other forms of combustion ought to give rise to a purer air. Such however is not the case. Gas was burned in a glass receiver, and supplied with filtered air for combustion, and it was found that the products of combustion of pure air and dustless gas gave rise to an intensely fog-producing atmosphere It may be mentioned here that the fog-producing air from the heated glass, metals, and burning gas were each passed through the cotton-wool filter, and the air was in all cases made pure, and did not give rise to cloudiness when mixed with steam

It will be seen that it is not the dust motes which are revealed to us by a beam of sunlight when shining into a darkened room, that form the nuclei of fog and cloud-particles, as these may be entirely removed by heat, and yet the air remain active as a cloud-producer. The heat would seem to break up the larger motes which reflect the light into smaller and invisible ones When speaking of dust, it is to these infinitesimally small and invisible particles we refer. The larger motes which reflect the light will no doubt be active nuclei, but their number is too small to have any important effect.

It is suggested, and certain reasons are given for supposing, that the blue colour of the sky is due to this fine dust.

Other experiments were made to test the fog-producing power of the air and gases from different sources The air to be tested was introduced into the experimental receiver and mixed with steam, and the relative densities of the fog produced were noted It was always found that the air of the laboratory where gas was burning gave a denser fog than the air outside, and that the air outside varied, giving less fog during wet than during dry weather. The products of combustion of gas burned in a Bunsen flame, a bright flame, and a smoky flame, were all tested and found to be about equally bad, and all much worse than the air in which they were burned. Products of combustion from a clear fire and from a smoky one gave about equal fogging, and both much worse than the air of the room.

Experiments were made by burning different substances. Common salt when burned in a fire or in alcohol flame gave an intensely fog-producing atmosphere, but burned sulphur was the most active substance experimented on It gave rise to a fog so dense it was impossible to see through a thickness of 5 cm of it

The vapours of other substances than water were tested to see if they would condense in the cloud form without nuclei on which to deposit All the substances experimented on, which included sulphuric acid, alcohol, benzole, and paraffin, only gave a cloudy condensation when mixed with ordinary unfiltered air, and remained perfectly clear when mixed with filtered air, all these acting like water vapour

Before referring to fogs, which have now become so frequent and aggravated in our large towns, it was pointed out that caution was necessary in applying the results of the experiments

The conditions of a laboratory experiment are so different, and on so small a scale, that it is not safe to carry their teaching to the utmost limits and apply them to the processes which go on in nature. We may, however, look to the experiments for facts from which to reason, and for processes which will enable us to understand the grander workings of nature.

It having been shown that vapour, by condensing on the dust-particles in the air, gives rise to a fogging, the density of which depends on the amount of fine dust in the air, the more dust the finer are the fog-particles, and the longer they remain suspended in the air. It having been also shown that all forms of combustion, perfect and imperfect, are producers of fog nuclei, it is concluded that it is hopeless to expect that, adopting more perfect forms of combustion than those at present in use, we shall thereby diminish the frequency, persistency, or density of our town fogs More perfect combustion will, however, remove the pea-soup character from the fogs

and make them purer and whiter, by preventing the smoke which at present mixes with our town fogs and aggravates their character, and prevents them dissolving when they enter our rooms Smoke descends during a fog, because the smoke particles are good radiators, and soon get cooled and form nuclei on which the water vapour condenses. The smoke thus becomes heavier and falls. This explains why falling smoke is often a sign of coming rain It indicates a saturated condition of the atmosphere

Sulphur when burned has been shown to be an intensely active fog-producer. Calculation shows that there are more than 200 tons of sulphur burned with the coal every winter day in London, a quantity so enormous as quite to account for the density of the London fogs It is suggested that some restriction ought to be put on the amount of sulphur in the coal used in towns

Before utterly condemning the smoke and the sulphur, it was pointed out that it would be necessary thoroughly to investigate and fully to consider the value of smoke as a deodoriser, and also the powerful antiseptic properties of the sulphurous acid formed by the burning sulphur The air during fogs is still and stagnant There is no current to clear away the foul smells and deadly germs that float in the air, which might be more deadly than they are, were it not for the suspended soot and burned sulphur We must therefore be on our guard lest we substitute a great and hidden danger for an evident but less evil.

ON THE SPECTRUM OF CARBON

ALTHOUGH fifteen years have passed since the possibility of one substance possessing more than one spectrum was first suggested by Plucker and Hittorf, the question of the existence of double spectra cannot yet be considered as decided One of the elements to which multiple spectra have been attributed is carbon, which was at one time supposed to possess four different spectra of these one has been shown to be due to oxide of manganese, a second to oxides of carbon, the origin of a third (obtained only from oxides of carbon) has hardly been discussed (though it may prove to be one of the true carbon spectra), and the other "carbon" spectrum—the best known of all—is the one first attributed to carbon by Attfield, but ascribed to acetylene by Angstrom

In a paper read before the Royal Society, and of which an abstract is given in NATURE, vol xxii p 620, Professors Liveing and Dewar describe experiments to prove that this spectrum is that of a hydrocarbon, and not of carbon itself, and also that certain blue bands, best seen in the flame-spectrum of cyanogen, are due to compounds of carbon and nitrogen, and not to carbon itself. They attribute to hydrocarbon (amongst others) the yellowish-green group, which we will call γ, of wave-lengths from about 5635 to 5478, and the emerald-green group, which we will call δ, of wave-lengths from about 5165 to 5082, and they attribute to nitro-carbon the two blue groups of wave-lengths 4600 to 4502 and 4220 to 4158, which we will call θ and ζ respectively

As these result are directly opposed to my own experience, I have thought it necessary to repeat two of the experiments described in my paper on the carbon spectra in the *Philosophical Magazine* for October, 1869, under such conditions as to exclude (as far as lay in my power) all trace of hydrogen in the one case, and of nitrogen in the other

The difficulty of supposing carbon to be present in the state of vapour at any temperature which we can command seems to be the chief reason why so many investigators think it necessary to attribute the spectrum in question (with experimental evidence or without it) to compounds of carbon I am not aware that Ångström ever gave any experimental proof of his assertion that this spectrum was caused by acetylene

On the other hand, the evidence that the spectrum is due to carbon is that first stated by Attfield, that if these lines "are absent in flames in which carbon is absent, and present in flames in which carbon is present," if they are "observable equally in the flame of the oxide, sulphide, and nitride as well as in the hydride of carbon," and if "present whether the incandescence be produced by the chemical force, as in burning jets of the gases in the open air or by the electric force, as when hermetically-sealed tubes of the gases are exposed to the discharge of a powerful induction-coil," then they "must be due to incandescent carbon vapour" , and if this is borne out by experiment the conclusion that the lines are due to carbon (as gas, liquid or solid) cannot be resisted, whatever may be the apparent impossibility of volatilising or even liquifying carbon, even by the most powerful current of electricity directed through it

We must bear in mind how very small a quantity of a gas is often sufficient to give us a spectrum, and when the carbon spectrum is obtained by the decomposition of olefiant gas or cyanogen by passing sparks through the gas, the carbon certainly exists as gas in the compound which is decomposed, and before the liberated atoms unite together to form the molecules of the solid, there is surely no impossibility in their existing for the moment as gas—as gaseous carbon

On an examination of Professors Liveing and Dewar's paper to ascertain the experimental evidence upon which the bands γ and δ are attributed to hydrocarbon and not to carbon itself, we find it stated that "the green and blue bands characteristic of the hydrocarbon flame seem to be always present in the arcs, whatever the atmosphere. This is what we should expect if they be due, as Angstrom and Thalén suppose, to acetylene, for the carbon electrodes always contain, even when they have been long heated in chlorine, a notable quantity of hydrogen"

Since then it is impossible to completely expel hydrogen from the carbon-poles, we must reject all the experiments in which the electric arc was observed in atmospheres of different gases, although "the green and blue hydrocarbon bands were seen more or less in all of them"

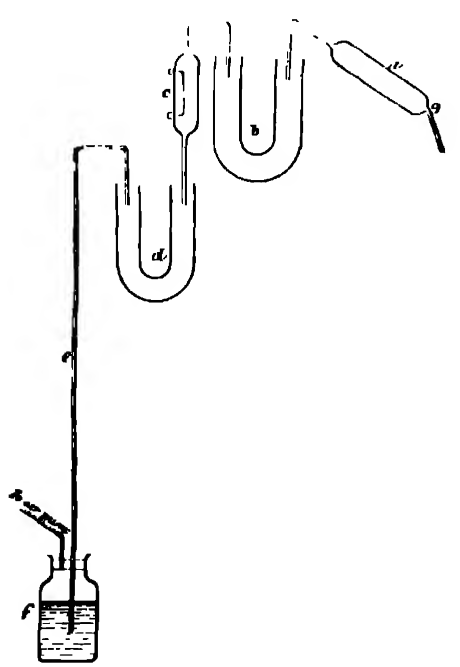
Turning then to other methods of producing the spectrum, we find it stated that in the flame of carefully-dried cyanogen "the hydrocarbon bands were almost entirely absent" (they should have been *entirely* absent), "only the brightest green band was seen, and that faintly." Hence we are to infer, I suppose, that the bands γ and δ, so brilliant in the flame of cyanogen in air or oxygen, are due to the accidental presence of hydrogen (see the extract from Moiren's paper, NATURE, vol. xxii p 7 Dibbits also speaks of this spectrum as "by far the most magnificent" he has seen)

Next we have the experiment of burning hydrocyanic acid, in which, as we have hydrogen present, we expect to find the hydrocarbon bands brilliantly developed But we find the result stated as "very much the same as that of cyanogen" The flames of hydrogen and sulphide of carbon, and of hydrogen and carbonic oxide, do not give the hydrocarbon bands (their spectra being continuous), a mixture of hydrogen and carbon tetrachloride gives them faintly, and a mixture of hydrogen and chloroform gives them strongly

In all this we have no *proof* of the point in question, nor even any special probability that the bands are due to hydrocarbon , and yet, in the face of experiments in which the spectrum is obtained from cyanogen, when care has been taken to exclude hydrogen, we are asked to attribute the bands to the hydrocarbon formed by combination with some trace of hydrogen (as water or otherwise), supposed to be present as impurity. In the same way the presence of the bands θ and ζ obtained under circumstances when nitrogen has been intentionally excluded, is to be explained by "the extreme difficulty of

removing the last traces of air." So that in the case of cyanogen with a trace of hydrogen present, the spark persists in giving us the spectrum of hydrocarbon; and when we have naphthalin with a trace of nitrogen present, it gives us the spectrum of nitrocarbon!

Attfield states that the spectrum in question is obtained from *pure dry* cyanogen. "The ignition of the gases having been effected in air, it was conceivable that hydrogen, nitrogen, or oxygen had influenced the phenomena. To eliminate this possible source of error the experiments were repeated out of contact with air. A thin glass tube one inch in diameter and three inches long, with platinum wires fused into its sides and its ends prolonged by glass quills having a capillary bore, was filled with *pure dry* cyanogen, and the greater portion of this gas then removed by a good air-pump. Another tube was similarly prepared with olefiant gas. The platinum wires in these tubes were then so connected with each other that the electric discharge from a powerful induction-coil could pass through both at the same time. On now observing the spectra of these two lights in the simultaneous manner previously described, the



characteristic lines of the hydrocarbon spectrum were found to be rigidly continued in that of the nitrocarbon. Moreover, by the same method of simultaneous observation the spectrum of each of these electric flames, as they may be termed, was compared with the corresponding chemical flames, that is with the oxyhydrocarbon and oxynitrocarbon jets of gas burning in air. The characteristic lines were present in every case."

"The spectrum under investigation having then been obtained in one case when only carbon and hydrogen were present, and in another when all elements but carbon and nitrogen were absent, furnishes to my mind sufficient evidence that the spectrum is that of carbon."

Morren also adopted this method of producing the spectrum by taking the spark of an induction coil in a sufficiently rapid current of pure cyanogen at atmospheric pressure.

I have again repeated this experiment with cyanogen under conditions which would seem to ensure that the gas should be dry (see also *Phil Mag*, 1875).

The cyanogen was prepared by heating pure cyanide of mercury, which was finely powdered and placed in a piece of combustion-tubing (*a*) drawn out at both ends. In this it was repeatedly heated to the temperature of incipient decomposition whilst a current of dry air was drawn over it. One end of the tube was then closed by fusion at the point *g*, and the other bent round and fitted, as shown in the figure, to a U-tube (*b*) containing phosphoric anhydride—the discharge-tube *c* was interposed between this U-tube and a second U-tube *d* also containing phosphoric anhydride, the other branch of which was connected to one end of a vertical tube *e* of more than thirty inches in length, the lower end of which passed into mercury contained in the bottle *f*, the upper portion of which could be exhausted by means of the air-pump. The connections with the U-tube were made by means of perforated india-rubber stoppers, and the joints were surrounded during the experiment by melted paraffin.

The apparatus having been exhausted, the mercuric cyanide was heated till the apparatus was filled with cyanogen at atmospheric pressure, it was then again exhausted and again filled with cyanogen. After having been thus exhausted and re-filled five or six times, the spectrum of the spark between the wires at *c* was examined at various pressures. The spectrum figured in my paper in the *Philosophical Magazine* for October, 1869, was obtained, the groups γ and δ, with which alone we are at present concerned, being the brightest in the whole spectrum. Next careful search was made for the red hydrogen line. The cross-wires of a one-prism spectroscope were accurately adjusted to the red line, as seen in a hydrogen vacuum tube, and the spectroscope was then directed upon the spark in the cyanogen. No trace of the line could be observed.

A second experiment was devoted to the examination of the spark in an atmosphere of naphthalin vapour, from which nitrogen had been excluded as far as possible, in order to ascertain whether the bands ζ and θ, which Professors Liveing and Dewar attribute to cyanogen, would be produced. Professors Liveing and Dewar are somewhat in error in saying that I laid much stress on the occurrence of these bands in carbonic oxide. They were never obtained very brilliantly from carbonic oxide (except under pressure), but they are obtained brilliantly from a naphthalin vacuum tube. I have obtained them also from a vacuum tube containing pure marsh-gas (my note-book remarks "θ very bright"), and as confirmation by an independent observer, I would remark that Plucker maps them in the spectrum of a vacuum tube containing *methyl*.

The vacuum tube in this second experiment contained pure solid naphthalin fused on the sides of the tube, this was placed in position so that the upper end passed through one hole in an india-rubber stopper into a flask filled with carbon dioxide, a vertical tube of thirty inches length passed through the second hole in the stopper of the flask, and its lower end dipped below mercury. The whole of the vacuum tube except the lowest portion was surrounded by a wider tube containing melted paraffin.

When the apparatus had been arranged, the experiment was commenced by passing a rapid current of carbonic acid through the vacuum tube, so as to fill the flask and escape through the mercury. After passing the gas for a considerable time, the lower end of the tube was closed by fusion, the naphthalin all melted down into this end, where it was made to boil violently, while the paraffin was maintained at a temperature of about 220° C. After the current of naphthalin vapour had lasted some time, the upper end of the tube was closed by fusion, the tube removed and cooled, and its spectrum examined. It gave a spectrum in which the groups ζ and θ were plainly seen.

It is to be hoped that some independent observer will repeat these experiments, so as finally to settle the question of the origin of these bands of what I must still call the "carbon" spectrum. W. M. WATTS

THE INDO-CHINESE AND OCEANIC RACES—TYPES AND AFFINITIES

I

THE ethnological area here under consideration comprises the south-eastern corner of the Asiatic mainland, and nearly the whole of the Indian and Pacific Oceans. Of the three great divisions of the human family—the black, yellow, and fair—the two former alone are usually supposed to be represented in this region, the black by the Australians, extinct Tasmanians, Melanesians or Papûans, and Negritos, the yellow by the Indo-Chinese (Annamese, Siamese, Burmese, &c.), of the mainland, and the so-called "Malayo-Polynesians" of Oceanica. But it will be one of the main objects of these papers to show that room must here be henceforth made for the third also, and that most of the difficulties associated with the mutual classification of the other two are due to the omission or neglect of this third factor in the problem. It has long been an accepted doctrine of ethnologists that this fair or Caucasian type, using the term "Caucasian" in Blumenbach's sense, is limited by some mysterious law of nature or providential arrangement to the western portion of Asia, to the northern section of its African, and to nearly the whole of its European peninsula. But anthropology is a very young science, and as facts accumulate and knowledge expands, many of its conclusions too hastily arrived at will have to be modified or abandoned. The time seems to have already arrived for very materially modifying the views hitherto entertained regarding the geographical limits of the Caucasian species, which, instead of being confined to a western corner of the Old World, will be found to have been diffused in prehistoric times eastwards to within 2,500 miles of the American continent.

But the acceptance or rejection of this new doctrine will of course depend largely on the various senses in which the terms type, species, race, are understood by the different monogenist and polygenist schools. For the orthodox monogenist these words can obviously have but a relative meaning, for if all are necessarily sprung of one created pair, all have also necessarily become differentiated into the now existing types, these types thus sinking to the category of mere varieties. But to polygenists of all shades such expressions may naturally convey an absolute sense, the fundamental species now existing having presumably been evolved in so many independent centres, and for these the only question will be in *how many* centres? Yet even they cannot consistently base their theory on the eternal fixity of species, for they are all of them otherwise, and necessarily believers in evolution. They must therefore admit the abstract possibility of such comparatively slight transformism as the development of the dark from the yellow, the fair from either, lank from woolly hair, dolichocephaly from brachycephaly, the tall stature of the Tehuelch Patagonian from the pygmy Akka, or the reverse of all these processes. They may say that, assuming independent development from various anthropoids, such transformism is unnecessary to account for the present state of things, but they can never deny its inherent possibility, for it still remains a very trivial modification compared with the evolution of any given human from any given anthropoid type. Nor will they deny that in general differentiations of this sort are far more easy and explicable than independent growths, which involve so much more fundamentally radical changes. Consequently unorthodox monogenism, that is monogenism not starting from a created pair, but from one evolutionary centre, seems more rational and philosophic than any conceivable form of polygenism. This view seems in other respects to harmonise best with the actual conditions, and an effort has accordingly been made to give it expression in the subjoined definition of species, which differs in some important respects from those hitherto proposed. *Species is an aggregate of units resembling each other in all salient points, producing offspring of the same type in the same surroundings, or of continuously modified type in continuously modified surroundings, and themselves evolved of previous species similarly modified indefinitely.* Thus any given species or race (terms practically identical when used with scientific precision) exists only for the time being, is not and cannot be permanent, for it has become what it is by slow modification under slowly modified outward conditions, has had a beginning, may have an end. The best vindication of this truth is the geological record, which can only be explained either with Cuvier by the unwarranted assumption of successive fresh creations, or with common sense by regarding type or species as relative, not absolute concepts. Between the two views there seems to be no logical middle term.

It is therefore in this relative sense only that race or species are here to be understood, and in this sense it will be seen that all the three most fundamental types of mankind have existed from the remotest times in the wide area above defined. With their diverse modifications and intercrossings these three types form altogether seven main groups, which it will be convenient to take *seriatim* in the order adopted in the subjoined

General Scheme of Indo-Chinese and Oceanic Races

A.—DARK TYPES

I. NEGRITOS. Aetas, Andamanese, Samangs, Kalangs; Karons.

II. PAPÛANS.
- Central branch—Papûans Proper.
- Western branch—Sub-Papûans West (so called "Alfuros").
- Eastern branch—Sub-Papûans East (Melanesians).

III. AUSTRAL. Australians, Tasmanians (?)

B.—CAUCASIAN TYPE (Fair and Brown)

IV. CONTINENTAL BRANCH. Khmêr or Cambojan Group.

V. OCEANIC BRANCH. Indonesian and Sawaiori or Eastern Polynesian Groups.

C.—MONGOLIAN TYPE (Yellow and Olive Brown)

VI. CONTINENTAL BRANCH. Indo-Chinese Group.

VII. OCEANIC BRANCH. Malayan Groups.

A.—DARK TYPES

I. THE NEGRITOS. *Aetas, Andamanese, Samangs; Kalangs, Karons.*

Of the three divisions of this type shown in our scheme the Negrito is probably the most primitive. It seems to have formed the aboriginal element in South-East Asia and Malaysia at a time when the Archipelago was still connected with the mainland, but it is now represented only in a fragmentary way by the wild tribes in the Philippines collectively known as Aetas, Aitas, or Itas, the so-called "Mincopies" of the Andaman Islands, the little-known Samangs of Malacca, probably the Karus or Karons[1] of the Arfak Hills behind Geelvink Bay, New Guinea, and a few surviving members of the Kalangs of East Java. From a number of specimens recently brought to Europe, the osteology of the Aetas and Andamanese has been carefully studied, the former by Virchow in Germany, the latter by Prof. Flower in England, with parallel and in many respects identical results. Virchow[2] describes the Aetas as "a brachycephalous race differing altogether from the Papuans and Australian Negroes, and no less so from the African Negroes." He adds that they are "strongly prognathous," the profile of some

[1] Described by M. Raffray ("Tour du Monde," April 26, 1879) as essentially distinct from the Papûans. "Ce ne sont pas des Papous, mais bien des Negritos plus semblables aux sauvages aborigènes des Philippines qu'aux Papous Mélanésiens qui les entourent."

[2] In "Correspondenz-Blatt der deutschen Gesellschaft für Anthropologie," &c. 1872, p. 58.

crania consequently presenting an almost "orang-utan physiognomy." So also Prof. Flower[1] tells us that the Andamanese cranium is "as distinct as possible" from the Melanesian, and on all the available evidence he seems disposed to regard these islanders as "representing an infantile, undeveloped or primitive form of the type from which the African Negroes on the one hand, and the Melanesians on the other . . . . may have sprung." The relations of the Negritos to the Papûans, long a vexed question in anthropology, may thus be regarded as finally settled by the most competent authorities. One

Fig. 1.—Ape-like Type, Java. Ardi of Buitenzorg.

doubtless, originally, they must now be regarded as two distinct species in the relative sense involved in our definition of that term. C. Staniland Wake also points out another important feature in which the two races differ. The Papûans proper, and especially the Melanesians of Fiji, New Caledonians and Solomon Islanders, are frequently furnished with well-developed beards, whereas the Andamanese and all other true Negritos, are absolutely beardless. "The absence of the beard seems to be characteristic of all the Negrito peoples, and this trait may in my opinion be safely added to the con-

Fig. 2.—Andamanese Type. Mourning Head-dress.

Fig. 3.—Australian Type. Woman in Mourning.

clusions of de Quatrefages touching the small black races of the Archipelago."[2]

The ape-like appearance of the Aetas, already spoken of by de la Gironnière, and now insisted on by Virchow, receives a startling illustration from the accompanying portrait (Fig. 1) of a Javanese Kalang named Ardi, recently if not still employed as a workman in the famous Buitenzorg (Sans-Souci) Botanic Gardens near Batavia. Here he was seen by C. B. H. von Rosenberg in 1871, and reproduced at p. 569, vol. iii. of that naturalist's work on the "Malay Archipelago" from an original photograph by van Musschenbroek, which has also been

Fig. 4.—Full-blood Papûan Type. North-west Coast New Guinea.

figured on an enlarged scale in Dr. A. B. Meyer's monograph on the "Kalangs of Java." Notwithstanding its startling ape-like appearance all doubt as to the correctness of the portrait is removed by the independent testimony of von Rosenberg and van Musschenbroek, the latter of whom informs me through Prof. Veth of Leyden

Fig. 5.—Full-blood Papûan Type. North-west Coast New Guinea.

(Letter, October 16, 1880), that "he has met with the same type in other parts of Java, though not so pronounced, and that it could always be traced to a Kalang origin." He adds that "this race is fading away and that the intermixture with Common Javanese has become

[1] In paper "On the Osteology and Affinities of the Natives of the Andamanese Islands," in *Journal* of Anthropological Institute, November, 1879, pp. 132-3.

[2] *La barbe considérée comme caractère de races*, in *Rev. d'Anthrop.*, an. 15, 1880.

such that in most instances only faint traces of the peculiar type have been left." Meyer agrees with van Musschenbroek in regarding the Kalangs as a remnant of the aborigines of Java, possibly allied to the other

FIGS 6, 7.—Malayo-Papûan Mixed Types. Body-guard of the Sultan of Ternate

Negrito peoples of the Archipelago, and "occupying Java before it was peopled by the Malays" Ardi had come from the eastern parts of the island, where a few still linger no longer as a distinct tribe, but dispersed, like Ardi himself, amongst the general population Hence

FIG 8.—Melanesian Type Vanikoro Chief

the reader will doubtless be glad to have this authentic specimen of perhaps the very lowest type of mankind, now all but extinct.

Our next illustration (Fig. 2) is that of an Andamanese Negrito in a mourning head-dress, from a photograph sent to Europe by Mr. Man, and originally published in the *Anthropological Journal*, vol vii (1877) p. 416. It presents a singular resemblance to an Australian woman (Fig. 3) also in mourning, reproduced in the same place

FIG. 9.—A Motu Youth.

from a picture in Angus' "South Australia Illustrated", (plate 51)

The Negrito and Hottentot hair is usually described as growing in separate woolly tufts, or, as Topinard puts it, "in little peppercorn masses, separated by bald spaces" In his "Genealogical Classification" of the Human

FIG. 10.—Maori Type

Races and Languages" Venzel Kriżhek revives the well-known classification of Friedrich Muller which makes this feature the basis of one of the main divisions of mankind, including the Hottentots, Papûans, and Negritos. Yet the phenomenon has absolutely no existence in nature. But such is the tenacity of errors of this sort that

it seems impossible to dispel the delusion, although, as Prof. Flower well remarks, "the report of a committee of the Paris Anthropological Society on the growth of the hair of a Negro in one of the hospitals of that city, published last year (1879) in the *Bulletin* of the Society, ought to set the question at rest for ever" It is curious that evolutionists should have discovered in man a trait which is characteristic of none of the anthropoids

The Negritos, whether those described by Jagor and Meyer in the Philippines, or those visited by E. H. Man in the Andaman group, are all alike socially on the lowest level They are all nomadic, though not pastoral, moving about from hill to hill, from coast to river-bank, in search of food or shelter from the weather or their enemies. They live on the fruits and roots of the tropical woodlands, on wild honey, snakes, frogs, fish, or such game as their feeble weapons (mostly spear and bow and arrow) are able to procure them Yet, although indolent and incapable of providing for the future, they do not lack intelligence, for their brain capacity (index No 74) is still immensely greater than that of the highest anthropoid ape The Aetas often acquire a knowledge of the neighbouring Tagalog and Bisayan (Malayan) dialects, and the speech of the Andamanese seems from Man's specimens to belong to a highly agglutinating type. They appear to have no shrines or idols of any sort, in this greatly differing from the Papuans, and their religious thought is limited to a blind awe or fear of the powers of nature, for them doubtless supernatural manifestations But our knowledge of their inner life is still far too restricted to pronounce very positively on these points The Negritos are not generally suspected of cannibalism, but the Karons of New Guinea are certainly addicted to the practice One of them, although quite a youth, admitted to M Achille Raffray that he had already eaten fifteen men, treating it as quite a matter of course They appear, however, to confine themselves to the bodies of their enemies slain in battle, and do not regard every stranger as so much "meat," like the Negroes of the Lualaba-Congo

II. THE PAPÛANS. *Papûans proper, Sub-Papûans West ("Alfuros"), Sub-Papûans East (Melanesians)*

The Papûan domain is entirely oceanic, stretching in its widest sense from the island of Floris, Malaysia, eastwards to Fiji (120° – 180° E long), and from about the equator southwards to New Caledonia, at this point approaching the Tropic of Capricorn In our scheme are shown three branches, a central, western, and eastern, which grouping has the convenience of being at once geographical, and to a large extent ethnical The type itself, so named from the Malay word پُپُوَه (*papûwah* = frizzly), denoting one of its most striking characteristics, retains everywhere a considerable degree of uniformity in all essentials. But it is largely mixed with two distinct elements, the Malay in the west, the brown Polynesian or Sawaiori in the east No doubt there are mixtures in New Guinea or the central region also, and notably on the south-east coast, to which the brown Polynesians seem to have penetrated in more recent times But on the whole the bulk of the New Guinea people, including the adjacent Aru, Waigiu, Salwatty, Mysol, and Ké islanders, may be taken as the most typical branch of the race The western division, composed of Malayo-Papûans, and often vaguely spoken of as "Alfuros," but whom I name Sub-Papûans West, comprises the Malaysian islands of Floris, Jilolo, Ceram, Buro, Goram, Timor, Wetter, Timor Laut, and neighbouring islets, without prejudice to the question of Papûan blood in Borneo and Celêbes. The eastern division, composed mainly of Sawaiori-Papûans, and whom I name Sub-Papûans East, comprises all the South Pacific Islands grouped as Melanesia. This term, Melanesia, referring to the prevailing black colour of the natives, is in every way convenient, so that Sub-Papûan East and Melanesian may be taken as practically synonymous. Here the chief groups are the Admiralty, New Britain, New Ireland, Solomon, New Hebrides, New Caledonia, Fiji, and it is to be noted that there are some, possibly many, Melanesians who betray no trace of mixture with the brown Polynesians, and who must consequently be regarded as pure Papûans. Such are the Vanicoro and Mallicolo people in the New Hebrides, and especially the Kai Colos of Viti Levu in Fiji, some specimens of whose crania Prof. Flower has recently shown to be absolutely the most dolichocephalous on the globe. As brachycephaly is a distinctive mark of the Negrito, so dolichocephaly is of the Papûan type Consequently on this easternmost verge of the Papûan area we would seem to have, as far as is known, the very purest specimen of the race This harmonises with the view I have ventured elsewhere to express, that the type was developed in a now submerged South Pacific Continent, moving westwards with the gradual subsidence of the land For a long way east of New Guinea and North-East Australia, in fact quite as far as Samoa, the water is very shallow, averaging probably not more than 500 fathoms.

The accompanying illustrations may be taken as typical specimens of the three great divisions of the Papûan family Characteristic full-blood Papûan types are those of two members of the Wosaoni tribe, North-West Coast of New Guinea (Figs 4 and 5), from portraits by M. Raffray, originally figured in the *Tour du Monde*, for April, 1879 p 267 In Figs 6 and 7 we have good specimens of the so-called "Alfuros," or mixed Malayo-Papûans of the Archipelago, from sketches by M. Rosenberg, reproduced in his "Malay Archipelago," vol. ii. p 401. The Vanikoro chief (Fig 8), from Stanford's "Australasia," p. 476, represents a pure Melanesian head, extremely narrow and high, with long straight, but somewhat broad (platyrhine) nose and frizzly hair. In this front view the prognathism and dolichocephaly are of course not so perceptible as they would be in profile The Motu youth (Fig 9), from Stone's work, "A Few Months in New Guinea" (Sampson Low and Co), illustrates the sub-Papûan East type, the moppy head being thoroughly Papûan, while the broad face, implying brachycephaly, must be referred to Sawaiori influences. The Motu people occupy a strip of about sixty miles on the south-east coast of New Guinea about Port Moresby, and speak a language of the Sawaiori type, apparently more allied to Samoan than to Malay. O C. Stone's statement that they reckon up to one million must be received with caution, for the Samoans themselves cannot get beyond 10,000, while the Malays draw the line at 100,000 The familiar Maori (New Zealand) head (Fig 10), from Stanford's "Australasia," p 565, seems to support the now generally accepted view that the Maoris are not pure brown Polynesians, but a mixture of Rarotongans (Sawaiori stock) and Melanesians, the former predominating According to some of their traditions on their arrival, probably some 600 years ago, they found the islands occupied by an aboriginal people, who must have been Melanesians, and who were partly exterminated and partly absorbed.

In point of culture the Papûans take a far higher place not only than the Negritoes and Australians, but even than most of the African Negroes. They build houses preferably on piles, cultivate the land with great care and intelligence, are everywhere settled in fixed tribal communities governed by well-understood usages. Alfred R. Wallace, a careful observer of this race, ranks them intellectually higher even than the Malays, accounting for their social inferiority by their less favourable surroundings and remoteness from the civilising influences of more highly-cultured peoples. A very pleasing account is given by Cook of his visit to the New Caledonians, who are generally regarded as an unfavourable branch of the

family. He describes the land about the villages as "finely cultivated, being laid out in sugar-canes, plantations, yams, and other roots, and watered by little rills conducted by art from the main stream, whose source was in the hills. . . Some roots were baking on a fire in an earthern jar which would have held six or eight gallons, nor did we doubt its being their own manufacture." And further on "The plantations were laid out out with great judgment, and cultivated with much labour." The reference to earthenware is curious, because the Polynesians are generally supposed to be ignorant of the potter's art. But a taste for art in general, and especially for decoration, is one of the most distinguishing features of the Papûans Their arms, idols, houses, boats, and other objects are often adorned with very tasteful and elaborate designs, and some of their tatooing presents extremely elegant patterns They have domesticated the pig, dog, and poultry, and they cultivate the yam, sweet potato, banana, sugar-cane, taro, bread-fruit, and mango Amongst their arms, besides the spear and bow, are the bamboo blowpipe, and flint knives and axes like those of the neolithic age in Europe. Cannibalism seems to be extremely rare in the West and in New Guinea, but until suppressed was universal in New Zealand and Fiji, and is still prevalent in New Britain and many other parts of Melanesia From this division of the family it seems to have passed to the brown Polynesians, many of whom were formerly addicted to the practice It reached its climax in Fiji when, shortly before the annexation of these islands to Great Britain, a whole tribe was condemned to be roasted alive and eaten. As they were too numerous to be consumed at one meal, it was arranged that at the annual taro harvest one family should be baked and eaten with that esculent, and the arrangement was scrupulously carried out until the annexation seasonably intervened to save a remnant of the tribe (*De Rici*)

A H KEANE

(*To be continued*)

PROF. HUXLEY ON EVOLUTION

AT the meeting of the Zoological Society on December 14, among the papers read was one by Prof Huxley on the application of the laws of evolution to the arrangement of the vertebrata, and more particularly of the mammalia.

We take the following report of the paper from the *Times* —

Prof Huxley began by saying.—There is evidence, the value of which has not been disputed, and which, in my judgment, amounts to proof, that, between the commencement of the Tertiary epoch and the present time, the group of the Equidæ has been represented by a series of forms, of which the oldest is that which departs least from the general type of structure of the higher mammalia, while the latest is that which most widely differs from that type In fact, the earliest known equine animal possesses four complete sub-equal digits on the fore-foot, three on the hind-foot, the ulna is complete and distinct from the radius, the fibula is complete and distinct from the tibia; there are forty-four teeth, the full number of canines being present, and the cheek-teeth having short crowns with simple patterns and early-formed roots The latest, on the other hand, has only one complete digit on each foot, the rest being represented by rudiments; the ulna is reduced and partially ankylosed with the radius, the fibula is still more reduced and partially ankylosed with the tibia, the canine teeth are partially or completely suppressed in the females; the first cheek-teeth usually remain undeveloped, and when they appear are very small, the other cheek-teeth have long crowns, with highly complicated patterns and late-formed roots. The Equidæ of intermediate ages exhibit intermediate characters. With respect to the interpretation of these facts, two hypotheses, and only two, appear to be imaginable. The one assumes that these successive forms of equine animals have come into existence independently of one another The other assumes that they are the result of the gradual modification undergone by the successive members of a continuous line of ancestry. As I am not aware that any zoologist maintains the first hypothesis, I do not feel called upon to discuss it. The adoption of the second, however, is equivalent to the acceptance of the doctrine of evolution so far as horses are concerned, and, in the absence of evidence to the contrary, I shall suppose that it is accepted.

Since the commencement of the Eocene epoch, the animals which constitute the family of the Equidæ have undergone processes of modification of three kinds. (1) there has been an excess of development of one part of the oldest form over another; (2) certain parts have undergone complete or partial suppression, (3) parts originally distinct have coalesced. Employing the term "law" simply in the sense of a general statement of facts ascertained by observation, I shall speak of these three processes by which the Eohippus form has passed into Equus as the expression of a three-fold law of evolution. It is of profound interest to remark that this law, or generalised statement of the nature of the ancestral evolution of the horse, is precisely the same as that which formulates the process of individual development in animals generally, from the period at which the broad characters of the group to which an animal belongs are discernible onwards. After a mammalian embryo, for example, has taken on its general mammalian characters, its further progress towards its special form is effected by the excessive growth of one part in relation to another, by the arrest or suppression of parts already formed, and by the coalescence of parts primarily distinct This coincidence of the laws of ancestral and individual development, creates a strong confidence in the general validity of the former, and a belief that we may safely employ it in reasoning deductively from the known to the unknown. The astronomer who has determined three places of a new planet calculates its place at any epoch, however remote, and, if the law of evolution is to be depended upon, the zoologist who knows a certain length of the course of that evolution in any given case, may with equal justice reason backwards to the earlier, but unknown stages. Applying this method to the case of the horse, I do not see that there is any reason to doubt that the Eocene Equidæ were preceded by Mesozoic forms, which differed from Eohippus in the same way as Eohippus differs from Equus. And thus we are ultimately led to conceive of a first form of the equine series, which, if the law is of general validity, must need have been provided with five sub-equal digits on each plantigrade foot, with complete, sub-equal antebrachial and crural bones, with clavicles, and with, at fewest, forty-four teeth, the cheek-teeth having short crowns and simple-ridged or tuberculated patterns. Moreover, since Marsh's investigations have shown that the older forms of any given mammalian group have less-developed cerebral hemispheres than the later, there is a *primâ facie* probability that this primordial hippoid had a low form of brain. Further, since the existing horse has a diffuse allantoic placentation, the primary form could not have presented a higher, and may have possessed a lower, condition of the various modes by which the fœtus derives nourishment from the parent Such an animal as this, however, would find no place in any of our systems of classification of the mammalia. It would come nearest to the Lemuroidea and the Insectivora, though the non-prehensile pes would separate it from the former, and the placentation from the latter group

A natural classification is one which associates together all those forms which are closely allied, and separates them from the rest. But, whether in the ordinary sense of the word "alliance," or in its purely morphological sense, it is impossible to imagine a group of animals more closely

allied than our primordial hippoids are with their descendants Yet, according to existing arrangements, the ancestors would have to be placed in one order of the class of mammalia and their descendants in another It may be suggested that it might be as well to wait until the primordial hippoid is discovered before discussing the difficulties which will be created by its appearance. But the truth is that that problem is already pressing in another shape Numerous "lemurs," with marked ungulate characters, are being discovered in the older Tertiaries of the United States and elsewhere, and no one can study the more ancient mammals with which we are already acquainted without being constantly struck with the insectivorous characters which they present In fact, there is nothing in the definition of either Primates, Carnivores, or Ungulates, which affords any means of deciding whether a given fossil skeleton, with skull, teeth, and limbs almost complete, ought to be ranged with the Lemurs, the Insectivores, the Carnivores, or the Ungulates.

In whatever order of mammals a sufficiently long series of forms has come to light they illustrate the three-fold law of evolution as clearly, though perhaps not so strikingly, as the equine series does Carnivores, Artiodactyles, and Persso-sodactyles all tend, as we trace them back through the Tertiary epoch, towards less modified forms which will fit into none of the recognised orders, but come closer to the Insectivora than to any other It would, however, be most inconvenient and misleading to term these primordial forms Insectivora, the mammals so-called being themselves more or less specialised modifications of the same common type, and only, in a partial and limited sense, representatives of that type The root of the matter appears to me to be that the palæontological facts which have come to light in the course of the last ten or fifteen years have completely broken down existing taxonomical conceptions, and that the attempts to construct fresh classifications upon the old model are necessarily futile The Cuvieran method, which all modern classifiers have followed, has been of immense value in leading to the close investigation and the clear statement of the anatomical characters of animals But its principle, the association into sharp logical categories defined by such characters, was sapped when Von Baer showed that, in estimating the likenesses and unlikenesses of animals, development must be fully taken into account, and if the importance of individual development is admitted, that of ancestral development necessarily follows. If the end of all zoological classification is a clear and concise expression of the morphological resemblances and differences of animals, then all such resemblances must have a taxonomic value But they fall under three heads (1) those of adult individuals; (2) those of successive stages of embryological development or individual evolution, (3) those of successive stages of the evolution of the species, or ancestral evolution. An arrangement is "natural," that is, logically justifiable, exactly in so far as it expresses the relations of likenesses and unlikenesses enumerated under these heads Hence, in attempting to classify the Mammalia, we must take into account not only their adult and embryogenetic characters, but their morphological relations, in so far as the several forms represent different stages of evolution And thus, just as the persistent antagonism of Cuvier and his school to the essence of Lamark's teachings (imperfect and objectionable as these often were in their accidents) turns out to have been a reactionary mistake, so Cuvier's no less definite repudiation of the principle of Bonnet's "*échelle des êtres*" was no less unfortunate. The existence of a "scala animantium," is a necessary consequence of the doctrine of evolution, and its establishment constitutes, I believe, the foundation of scientific taxonomy. Many years ago, in my lectures at the Royal College of Surgeons, I particularly insisted on the central position of the Insectivora among the higher Mammalia; and further study of this order and of the Rodentia has only strengthened my conviction that any one who is acquainted with the range of variation of structure in these groups possesses the key to every peculiarity which is met with in the Primates, the Carnivora, and the Ungulata Given the common plan of the Insectivora and of the Rodentia, and granting that the modifications of the structure of the limbs, of the brain, and of the alimentary and reproductive viscera which occur among them may exist and accumulate elsewhere, and the derivation of all Eutheria from animals which, except for their diffuse placentation, would be Insectivores, is a simple deduction from the law of evolution. I venture to express a confident expectation that investigation into the mammalian fauna of the Mesozoic epoch will, sooner or later, fill up the blanks which at present exist in the "scala mammalium" Prof. Huxley proceeded to give details on which his conclusions were based, and dwelt on the fact that much further careful work is needed to clear up problems before us

NOTES

We are enabled through the courtesy of the Council of the Royal Society of Edinburgh to present our readers with an abstract of a remarkable paper by Mr John Aitken, on Dust, Fog and Mist The paper opens up new lines of inquiry, and indeed a new future, to what has hitherto been one of the most difficult branches of meteorology, viz the investigation of the vapour of the atmosphere, which we may safely predict meteorologists will not be slow in following up Mr. Aitken continues the prosecution of the inquiry, and we learn that last week he has experimented with temperatures as low as 14°·0 F. with the result that equally as at higher temperatures, there is no cloudy condensation when there is no dust, but, when there is dust, cloudy condensation takes place on the dust nuclei, the amount of cloudiness being of course relatively small at such low temperatures on account of the small amount of vapour present. Taken along with Prof. Lister's experiments, in which it was shown that a single drop of rain developed organisms in sensitive solutions which would otherwise have remained for months unaltered, it shows that germ-producing matter, or germs themselves, form at least a part of the cloud- and fog-producing dust. Hence a cotton-wool respirator may prove a protection against disease We have said enough to show that the paper is one of interest, not only to the physicist and the meteorologist, but also (and perhaps even specially) to the physiologist and the sanitarian.

We are pleased to learn that Dr. W. De La Rue, F R S, has been chosen a Corresponding Member of the Paris Academy of Sciences in the Section of Astronomy

Baron de Chaudoir, Mr. McLachlan, and Baron C. R. Osten-Sacken have been elected honorary members of the Entomological Society of Belgium, filling the vacancies in the list caused by the deaths of Dr. Boisduval, M. Mulsant, and Dr. Snellen van Vollenhoven.

It is proposed to hold a meeting of the Association for the Improvement of Geometrical Teaching on Friday, January 7, in the Botanical Theatre of University College, Gower Street, at 11 a.m. The sub-committees appointed January 11, 1878, have prepared, and circulated amongst the members, draft syllabuses of solid geometry, higher plane geometry, and geometrical conics, and will present their Reports at the meeting. All persons interested in the elementary teaching of geometry are invited to attend.

According to a resolution of the St. Petersburg Society of Naturalists, the work of Prof. Wagner on "Medusæ and

Hydroids of the White Sea," will be published in German and French, with fifty tables of engravings.

THE Peabody Academy of Science (Salem, Massachusetts, U.S.A.), after a forced suspension of its publications for six years, announces that the *Memoirs* will be resumed at an early date.

DR. HOEK of Leiden writes us that a first part of the Zoological Results of the Dutch Arctic Cruises with the 60-ton Schooner *Willem Barents* will shortly be published. These results—a preliminary report of which Mr. D'Urban has given in the October number of the *Ann. and Mag. of Nat. Hist.*—will be published as an extra volume of the *Niederlandisches Archiv fur Zoologie* (Leiden, E. T. Brill). The different articles will be written in English, French, or German, and the distribution of the material has been as follows:—Sponges, Dr. G. C. J. Vosmaer; Echinoderms, Prof. C. K. Hoffmann; Hydroids and Polyzoa, Dr. W. J. Vigelius; Nemertineans, Dr. A. A. W. Hubrecht; other Worms, Dr. R. Horst; Pycnogonids and Crustaceans, Dr. P. P. C. Hoek; Lamellibranchiate Mollusks, Mr. D. van Haren Noman; Gastropodous Mollusks, Mr. Th. W. van Lidth de Jeude; Fishes, Dr. A. A. W. Hubrecht; Birds, Prof. H. Schlegel. The first part contains the Worms, the Pycnogonids, the Lamellibranchiate Mollusks, the Fishes, and a description of the only mammal captured, and will be issued before the end of January.

THE death is announced of Prof. Karl B. Heller of the K. K. Theresianum at Vienna, a naturalist well known by his numerous writings.

REPORTS from Honolulu describe an eruption of the Mauna Loa Volcano (Hawai) as the grandest which has ever been observed. It began on November 5 at some nine kilometres distance from the summit of the crater. The eruption of lava was accompanied by terrible explosions.

EARTHQUAKES are reported (1) from Brescia, where a shock was observed on December 10 in the afternoon; (2) from Schloss Trakostyan and environs (in the mountains of Northern Croatia), where three violent shocks occurred in the night of December 10-11; (3) from Smyrna, where, on December 12 at 9.40 p.m., a tolerably powerful shock was noticed. On the 23rd inst., about 5 p.m., a shock of earthquake was felt at Bucharest, Rustchuk, Kustendje, Galatz, Berlad, and Jassy. In the night of December 16-17 two earthquake shocks were felt in Agram, in close succession, about 11 p.m. About the same hour shocks were observed in various parts of Carniola and Styria, *e.g.* in Gurkfeld at 11.4 and 11.9 p.m., in Grossontag, near Friedau, three quickly-successive shocks; in Pragerhof two pretty sharp shocks; in Peltau and in Marburg one strong shock each. In Csakathurn (Hungary) and neighbourhood strong earthquake motions were likewise observed the same night about 11.20 p.m. In the night of December 21-22 shocks were again felt in Agram, of which one about 1 a.m. was pretty violent. In the environs of Agram slight earth-vibrations are still constantly being experienced. At about ten minutes past five o'clock p.m. on December 25 two rather severe shocks of earthquake occurred at Odessa within a very short interval of each other. They appear to have come from the direction of the Middle Danube, and, passing through Roumania and Bessarabia, spent themselves here on the shores of the Black Sea in South Russia. They seem to have been most strongly felt at the Bessarabian towns of Bieletz, Kishineff, and Tiraspol, for the walls of some of the houses were cracked in consequence. At Odessa the effects were limited to buildings and furniture being more or less roughly shaken, or light articles such as vases, bottles, and glasses, being thrown down. The weather was extremely mild and calm at the time, and the sky but very partially clouded.

FALB's theory is gaining in favour with the population, especially as he predicted fresh earthquakes in the Agram region from December 15 to 31. Falb has enunciated his theory in a newly-published popular work entitled "Die Umwälzungen im Weltall" (Revolutions in the Universe). These are treated under three heads: (1) in the star regions, (2) in the region of clouds, and (3) in the depths of the earth.

THE tomb of Immanuel Kant at Konigsberg will soon be decorated in a worthy manner. Upon a suitable pedestal a marble bust of the great philosopher will be placed. The bust is the work of Prof. Siemering.

"ALLERLEI gesammelte ornithologische Beobachtungen" is the title of a new book from the pen of Rudolf, Crown Prince of Austria, just published in a limited number of copies, which have been presented by the author to his friends.

A MONUMENT of the celebrated ornithologist Naumann was recently unveiled in the Schlossgarten at Kothen upon the occasion of the centenary of Naumann's birth.

THE German Fisheries Union have, according to the proposal of Prof. Nitsche of Tharand, resolved to offer a prize of 500 marks (25*l.*) for the best treatise on the following subject:—Of the ova of fish which are sown out for breeding, and particularly of the ova of the Salmonidæ, a large percentage is completely destroyed by fungi, well-known to pisciculturists as byssus or "mould," and belonging partly to the family of Schizomycetæ and partly to that of Saprolegniaceæ. A detailed botanical description of the respective genera and species, their biology and propagation, as well as an account of the manner of their introduction into the piscicultural apparatus, of the conditions which favour their development and of the way in which they destroy the ovum, is now required. At the same time the questions are to be discussed whether and by what means it would be possible to prevent their introduction, and what measures would best stop a continued spreading of the evil when once introduced into a breeding place. The treatises are to be sent, under the usual formalities, to the office of the German Fisheries Union, 9, Leipziger Platz, Berlin. The competition for the prize is to be an international one, and the treatises may be written in German, English, or French. The final term is October 1, 1882.

WE have received specimens of the diaries published by Messrs. De La Rue. While their beauty and convenience commend them to everybody, they ought to be of special value to lovers of science, as they contain so many scientific data. Their get-up and general utility are beyond praise.

THE *Comptes rendus* of the Paris Academy of Sciences for December 20 is entirely occupied with the discourses pronounced at the funeral of M. Michel Chasles by representatives of the various bodies with which the deceased member was connected—MM. J. Bertrand, Bouquet, Laussedat, Dumas, and Rolland.

AT the last meeting of the St. Petersburg Society of Gardening M. Grigorieff made an interesting communication on Japanese gardens. The Japanese are most passionate lovers of gardening, which is carried on by all classes of society, from the great palaces to the most humble houses. Gardening, as well as the art of making bouquets, is taught in schools, and nowhere else in Europe are there so many gardens as in Japan. The species cultivated in the small private gardens are mostly miniature representatives of great trees. All new species and varieties of garden flowers and trees are sold at high prices and become known throughout the country with great rapidity. M. Grigorieff exhibited during his lecture a most interesting collection of photographs of Japanese gardens.

THE Russian scientific bodies continue to express their sympathy with Prof. Mendeleeff on the occasion of the refusal

by the Academy of Sciences to admit him as Member of that body. The Russian Chemical and Physical Society, while electing him Honorary Member, has presented him with an address in which it is stated that the Society considers him "to be a chemist who has no equal among Russian chemists" Many scientific bodies, as the University of Kieff, the Society of Hygiene, &c, have elected him Honorary Member or President. A public subscription has been opened for the institution of a prize bearing his name, and a great dinner was given in his honour by the St Petersburg *savants*, among whom we notice the most eminent Russian Members of the Academy of Sciences It is worthy of notice that Professors Korkin and Setchenoff, as well as the late M. Hilferding, the Panslavist explorer of Slavonian literature, met at the hands of the Academy of Sciences the same fate as M. Mendeleeff.

THE law for the isolation of the French National Library has been adopted by both Houses of the French Parliament, and the necessary expropriation for the great work will begin immediately

AT a recent sitting the Municipal Council of Paris voted a sum of 400*l*. for the establishment of a School of Chemistry. It will be opened free to the pupils of the several Municipal schools who are desirous of practice in chemical industrie.

THE French Government is to establish in Egypt a school of Egyptology, which will be directed by M Maspero, now Professor of Egyptology to the College of France This creation will be the third school established abroad at the expense of the French Budget. The two others are one at Rome and the other at Athens.

THE Thirteenth Annual Report of the Eastbourne Natural History Society testifies to the Society's continued prosperity At the meeting of November 19 Dr Royston Pigott read an interesting paper on "The Limits of Human Vision"

THE *Proceedings* of the Belfast Natural History and Philosophical Society for 1878-80 contains, besides several general papers, a few natural history papers of local interest, including one (with illustrations) on Irish Spiders, by Mr Thomas Workman.

A BALNEOLOGICAL and a patent protection exhibition will be held at Frankfort-on the Main in 1881.

OUR ASTRONOMICAL COLUMN

VARIABLE STARS—Amongst the stars which, from a comparison of the various catalogues, exhibit more or less strongly signs of variability, may be mentioned the following, which we take in order of right ascension, the positions are for the year 1880:—

1 Lalande 2037-8. R.A. 1h. 3m. 24s, N P.D. 38° 30′ 5. On September 29, 1790, Lalande rated this star 10m., and on December 27 following, 8·9; the B.D. (by which letters we refer to the Bonn *Durchmusterung*) has 7 0. Harding marks it a ninth.

2 40 Cassiopeæ. R A. 1h 28m 57s, N.P n Lalande calls this star 4m. in September, 1789, and 6 i 1790. In Argelander's zone No. 167 on January 1, 1843, i was estimated 7, yet in the B.D. it is 5 2 In the first Radcliffe catalogue, where great attention was given to the magnitudes, it is 4 7, Piazzi has 6, Groombridge 5 6, and Heis the same.

3 Lalande 4864 5. R.A. 2h 32m. 15s., N.P D 40° 57′·4 Estimated 9 in September, 1790, and 7½ in January following; but it has since been discerned with the naked eye, Heis calling it 6 7. The B.D. has 6·7 It is not in Houzeau

4 Bradley 396. R.A 2h. 53m. 13s., N P.D. 8° 59′ 8. Lalande rated this star 4 5 in November, 1789, and 7 in March, 1790. Groombridge, who made six observations for position, estimated it 7, Heis and Carrington 6, while it is 5·5 in the B.D

5. 35 Camelopardi. We have already referred to the marked discordances in the estimates of the magnitude of this star in the various catalogues Dembowski has directed attention to the probable variability of the principal component, and the star certainly deserves more regular attention at the hands of observers than it has yet received. R.A. 5h. 54m 58s., N P D. 38° 25″5 The estimated magnitudes vary from 5 5 to 8.

6. Attention may be once more directed to the star which Rumker compared with Encke's comet at Paramatta, N S W., on June 19, 1822, and which he rated at the time 4 5 Whether it really attains this degree of brightness is not yet certain, it is however 6·0 in the *Uranometria Argentina*, and was observed as low as 8m. in 1873. The B D says 6 5. Its light is a full yellow R.A 7h 23m 15s, N.P D 91° 39′ 5.

7 65 b^3 Geminorum. R A 7h 22m 21s, N.P.D 61° 50′ 3. Lalande rated this star as low as 8¼ in March, 1794, but calls it 5½ in February following Bessel estimated it 7, all other observers say 5 or 5 6.

8 16 Leonis Minoris R A. 9h 42m 51s., N P D. 49° 48′ 7. D'Agelet has 5 and 7 8, Lalande 6½, Piazzi 8, the first Radcliffe Catalogue 6 6, Bessel, Taylor, and the B D 7, Houzeau 5 6, but neither Argelander nor Heis included it amongst the stars visible to the naked eye

9 Lalande 19034. R.A 9h. 34m. 49s, N.P D. 113° 2′ 7. It appears strange that a star isolated as this is should not have been more frequently observed on the meridian, if always as bright as say 5m. D'Agelet and Piazzi have not got it, Lalande calls it 4½ on March 21, 1797, Argelander has 6 on March 6, 1850, 4 on February 16, 1851, and 5 on March 8, 1852, Heis and Houzeau call it 5, and Gould 5 2.

If we may rely upon the observations of Kirch early in the last century there would appear to be sensible changes in the relative brightness of β and δ Scorpii, on January 17, 1704, he writes "β und δ erschienen fast im gleicher Grosse, jedoch δ ein wenig heller (jetzt ist β 2, δ 3 grosse)," while on April 1 following he records "δ merklich grosser als β" Argelander and Heis estimate β and δ respectively 2 and 2 3, Gould has no sensible difference.

10 Lalande 38405. R.A 20h, 0m. 16s, N.P D. 94° 45′ 4. This star was rated 6 on July 15, 1794, 7 on August 15, 8 on August 20, and 7½ on August 30 of the following year It is 8 in Bessel, 7 in Wolfer's map, one of the series of the Berlin Academy, and 6·7 in Heis and Houzeau Gould does not give it It might be inferred from Lalande's observations that the period is not very long

11 33 Capricorni. Chacornac says of this star. "Observée tantot plus brillante, tantot moins qu'une étoile de 7me grandeur dont elle est voisine" the seventh magnitude alluded to being, it may be presumed, O A 21386, which follows 2m. 12s., 9′·4 to the south 33 Capricorni is 5 6 in Argelander, 6·5 in Heis and Behrmann, and 5·7 in Gould, it is one of Chacornac's red stars, Gould also calls it red The evidence of variability in this case seems to rest with Chacornac R A 21h 17m 21s., N P D. 111° 21″5.

12. 17 ι Andromedæ, a star previously noted in this column as variable In the "British Catalogue" it is rated 4, Bradley and Piazzi call it 7; Lalande's three estimates are 5, 5 and 4, D'Agelet has 3 4 and 6, the first Radcliffe catalogue 3 9, and the B.D. 4 2; estimates from 4 to 7 are therefore sufficiently confirmed, the variation may be slow, but the star certainly deserves attention R A 23h 32m. 15s, N P D 47° 24′ 1.

THE COMET 1873 VII—The comet discovered by Coggia at Marseilles on November 10 and by Winnecke on November 11 was soon lost in Europe from its rapid southerly motion; indeed the observations extend over less than a week. The elements exhibited a similarity to those which had been assigned to a comet detected by Pons in February, 1818, but very imperfectly observed, and Prof. Weiss, the present director of the Imperial Observatory at Vienna, was at the trouble of examining the question of possible identity as closely as the data permitted. He formed three normal positions from the small number of observations—for November 11, 13, and 15—and under the condition that the first and third normals should be exactly represented he ascertained how the second one was represented on the assumption (1) that the orbit was parabolic, (2) that the period of revolution corresponded to the interval between the perihelion-passages in 1818 and 1873, or 55 82 years, and (3) that the comet had completed eight revolutions in this interval, or that the period extends only to 6 977 years. As a matter of figures the agreement was found to be slightly closer for hypothesis (3) than for the other two, the parabola showing the largest differ-

ence. Hence so far as the paucity of data in 1873 enabled any judgment to be formed, the preference appeared to belong to the revolution in 6·977 years. On this supposition there would be a very near approach to the orbit of Jupiter near the ascending node, which would render possible an amount of perturbation at some past time, that might have fixed the comet in an orbit of such limited dimensions.

If the comet were really revolving in an elliptical orbit with this period of revolution, neglecting perturbations, which might however be sensible since 1873, it would be again due at perihelion about November 24 in the present year, in which case its track in the heavens would not be very different from that followed in 1873. We are not aware if any search has been made for the comet. It would have been possible to have decided in 1873 if a short period were admissible could observations have been obtained in the southern hemisphere: this was not done, and the identity of the comets of 1818 and 1873 remains therefore open to conjecture; but it must be borne in mind that the data in the former year are in a high degree uncertain.

PECHULE'S COMET.—Elements computed by the discoverer from observations at Copenhagen on December 16, 17, and 20, have a general resemblance to those of the comet of 1807, so elaborately discussed by Bessel, but after his resulting period of many centuries, and considering the position of the orbit in the system, there can be of course no question of identity of these bodies. At Greenwich noon on January 1 the comet's position will be, by Pechule's elements, in R.A. 20h. 1·9m., N.P.D. 70° 24′, and on January 5 in R.A. 20h. 19·6m., N.P.D. 68° 30′.

CHEMICAL NOTES

MM. HAUTEFEUILLE AND CHAPPUIS, in continuing their investigation of the conditions under which oxygen is transformed into ozone, have shown in *Compt. rend.* that the character of the electric discharge to which the oxygen is subjected largely influences the quantity of ozone produced. If the discharge assume the character of a luminous shower the maximum amount of ozone is produced, the temperature of such a discharge being lower than that of the ordinary *effluve*. The production of this special form of discharge is ensured by mixing with the oxygen a small quantity of a foreign gas whose physical properties are dissimilar from those of oxygen; of the gases experimented with silicon fluoride has given the best results. If nitrogen be the foreign gas the transformation into ozone is greater than when pure oxygen is employed, but the discharge is not altogether luminous. Hydrogen is more effective than nitrogen. The presence of carbon dioxide also insures a large amount of ozonation. In their earlier experiments on the liquefaction of ozone the authors only succeeded in obtaining a mist in the Cailletet tube when the pressure was suddenly withdrawn. They now find that if a mixture of carbon dioxide and oxygen which has been ozonised at a low temperature be submitted to the action of the silent discharge at − 23°, and be slightly compressed, the gas acquires a deep blue colour, and after a time a blue liquid is produced. At − 88° the liquid is very dark blue. When carbon dioxide is decomposed by the electric spark at − 23° a blue gas is produced, and at a certain pressure (exact pressure is not mentioned) the undecomposed carbon dioxide condenses to a blue coloured liquid. By this experiment the authors think they have proved that ozone is one of the products of the decomposition, by the spark, of carbon dioxide.

THE heat of formation of benzene has recently been measured by Thomsen (*Berliner Berichte*) and by Berthelot (*Compt. rend.*). The results show considerable differences, but from the accounts of the experiments, Thomsen's number seems the more trustworthy. For the heat of combustion of gaseous benzene Thomsen finds the number 805,800 heat units; Berthelot the number 776,000. For the heat of formation of gaseous benzene, at constant volume, from amorphous carbon and hydrogen, Thomsen finds − 20,120 heat units; Berthelot, on the other hand, finds + 5800. Berthelot does not state whether this number is calculated for constant volume or constant pressure. Thomsen makes certain theoretical deductions from the value which he has found for the heat of formation of benzene, basing these on his calculations for the heat of formation of "singly- and doubly-linked" carbon atoms (see NATURE, vol. xxii. p. 608): he concludes that the generally accepted hexagon formula for benzene is probably incorrect, and that a formula in which each carbon atom is "singly linked" to three others is to be preferred.

BERTHELOT finds the heat of formation of gaseous dipropargyl—C_6H_6—a metamer of benzene—from amorphous carbon to be − 64,800 heat units. The instability and easy polymerisation of this body are explained by the great absorption of heat which occurs in its formation. Attempts to transform dipropargyl into benzene were unsuccessful. Berthelot has also determined the heats of formation of various hydrocarbons, and finds certain constant differences between the successive members of homologous series.

HERR V. MEYER describes in the *Berliner Berichte* a very elegant modification of his method of determining vapour densities, whereby the specific gravities of permanent gases may be readily measured at very high temperatures. At the highest temperature of a Schlösing's furnace (about 1400°) the density of hydrogen vapour was normal. It has now been shown that the coefficients of expansion of the following gases are not changed at very high temperatures: tellurium, sulphur, nitrogen, oxygen, hydrogen, mercury, carbon dioxide, hydrochloric acid, arsenious oxide.

THE following numbers for the vapour densities of tellurium and selenium have been recently obtained by Deville and Troost (*Compt. rend.*):—Selenium at 1420° = 5·68 (calculated = 5·54), tellurium at 1440° = 9·0, at 1390° = 9·08 (calculated = 8·93).

IN the *Wien Acad. Berichte* Herr Offer describes the results of experiments which he thinks show that Guthrie's cryohydrates are merely mixtures of various salts and ice: alcohol dissolves the ice, leaving a "skeleton" of undissolved salt; cold water dissolves the salt, and leaves the ice with the form of the cryohydrate. Solution of a cryohydrate is attended with the same thermal change as solution of the salt and ice separately.

THE connection which exists between the opium and cinchona alkaloids, and between both of these groups of compounds and pyridine, has been recently made more apparent by the work of Herr E. v. Gerichten (*Berliner Berichte*), who has shown that the so-called apophyllenic acid—obtained by oxidising the opium alkaloid cotarnine—is really the acid methyl salt of pyridine dicarboxylic acid, which acid is obtained from the cinchona alkaloid cinchonine, and which when heated with lime yields pyridine.

WHEN an aqueous solution of potassium, sodium, or lithium chloride, or potassium nitrate is kept for some time in a vertical tube, the upper part of which is maintained at a considerably higher temperature than the lower part, diffusion of the salt from the hotter to the colder part occurs, according to M. C. Soret (*Naturforscher*). The amount of diffusion in a given time depends upon the original concentration of the solution, and is also connected with the molecular weight of the salt used.

M. DUFET stated some little time since that the refractive index of a mixture of isomorphous salts in solution is equal to the mean of the indices of the components. Herr Fock (in *Zeitschrift für Crystallographie*) concludes, from measurements of the refractive indices of solutions of thallium and potassium alums, of lead and strontium thiosulphate, and of magnesium chromate and sulphate, that Dufet's statement does not hold good in all cases: for the second pair of salts mentioned above it is approximately correct. In *Compt. rend.* Dufet gives numbers showing that his statement applies to a mixture of magnesium and zinc sulphates.

In *Compt. rend.* M. Demarçay describes two new compounds containing sulphur, nitrogen, and chlorine, viz., SNCl and $(SN)_3Cl$: the former prepared by passing chlorine into a solution of nitrogen sulphide in chloroform, and the latter by adding nitrogen sulphide to a solution, in chloroform, of the compound SNCl. SNCl is partly decomposed by heat, in accordance with the equation $2SNCl = N_2 + S_2Cl_2$.

THE relation between the total energy developed in the chemical reactions which occur in various kinds of galvanic batteries and the energy which appears in the form of current electricity, has been recently studied by Thomsen (*Wiedemann's Annalen*) using a thermal method of measuring the total energy. He finds that the whole of the energy developed in the chemical change appears as electric energy in Daniell's battery (with closed circuit), and in those forms of batteries in which the metallic surface of the negative electrode is not changed by the electrolytic process; when nitric acid is used as electrolyte the same total conversion of one into another form of energy is

nearly realised, but the gradual absorption, by the liquid, of reduction products, tends to cause a deviation from this result.

BERTHELOT has recently studied (*Compt rend*) the action of air and of hydrochloric acid in presence of air, on pure mercury. He confirms the generally accepted fact that pure mercury is very slowly and superficially oxidised by the action of air at ordinary temperatures. If gaseous hydrochloric acid is shaken with mercury in presence of air mercurous chloride and water are produced. This reaction ($Hg_2 + 2HCl + O = Hg_2Cl_2 + H_2O$) is attended with the evolution of 53,400 thermal units, whereas the oxidation of mercury ($Hg + O = HgO$) is attended with the evolution of only 21,100 units. The action of hydrochloric acid in presence of air on copper ($Cu_2 + 2HCl + O = Cu_2Cl_2 + H_2O$) is accompanied by the evolution of 26,500 thermal units, hydrochloric acid in absence of air is, as is well known, almost without action on metallic copper.

IN the course of his investigation into the action of phosphorus on hydriodic acid, Damoiseau (*Compt rend*) describes a method for preparing phosphonium iodide in a state sufficiently pure for general use. Ten parts ordinary phosphorus in small pieces are allowed to react for some time on twenty-two parts of an aqueous solution of hydriodic acid (saturated in the cold), two parts iodine are added, and the phosphorous acid which is produced is separated from the crystals of phosphonium iodide by washing with aqueous hydriodic acid.

A SERIES of compounds, derived from monohydric alcohols, in which the "hydroxylic hydrogen" of the alcohol is replaced by aluminium, is described (*Chem News*) by Gladstone and Tribe. These bodies are prepared by the action of aluminium in presence of aluminium iodide on the alcohol. The new substances are solids, melting to clear liquids which do not solidify at temperatures much below the melting points of the solids, they are decomposed by water with formation of aluminium hydrate and the corresponding alcohol.

THE sulphides of vanadium have been investigated by Kay (*Chem. Soc Journ.*). The compounds obtained by Berzelius by the action of sulphuretted hydrogen on solutions of vanadium salts are shown to contain oxygen in addition to vanadium and sulphur, but no definite formula can be assigned to any of these bodies. Vanadium trisulphide V_2S_3 is obtained by the action of dry sulphuretted hydrogen on heated vanadium trioxide, as described by Berzelius. When this compound is heated to bright redness in hydrogen, it is reduced to the disulphide V_2S_2, and when heated with sulphur to 400° it is converted into the pentasulphide V_2S_5.

IN the *Chem. Soc. Journ* Kingzett describes experiments on the atmospheric oxidation of phosphorus which seem to prove that ozone and hydrogen peroxide are simultaneously produced when air is drawn over phosphorus partially immersed in water.

MANY so called basic sulphates of iron have been from time to time described: of the fifteen which are generally recognised as probably existing it would appear from Pickering's experiments (*Chem Soc. Journ.*) that only one, viz. $2Fe_2O_3\ SO_3$, actually exists.

DR. SYDNEY MARSDEN has recently experimented on the action of boron on various metals at high temperatures. He finds (*Proc R. S. Edin* and *Chem. Soc. Journ*) that silver dissolves amorphous boron, and that on cooling, pure boron is obtained partly in the graphitoidal, partly in the adamantine form. Copper combines with boron to form the compound B_2Cu_3.

PROF. BELLATI has published in pamphlet form, under the title "Proprietà termiche notevoli di alcuni Ioduri doppi," an extended and careful series of observations of the specific gravities, specific heats, thermal expansions, and thermal changes which accompany changes of colour and structure, of several double iodides of mercury, more especially of the three salts $HgI_2 . 2AgI$, $HgI_2 . 3AgI$, and $HgI_2\ Cu_2I_2$.

HERR HAASS describes in the *Berliner Berichte* a simple method of illustrating the existence of the so-called "critical pressure" described in this journal by Carnelley. A small piece of mercuric chloride is placed in a glass tube which is closed at one end, and communicates at the other with a Bunsen pump. So long as the manometer registers less than about 400 mm. pressure it is not possible to melt the mercuric chloride by heating it; the salt passes at once from the solid to the gaseous state. But immediately the pressure rises above about 420 mm. the mercuric chloride melts.

IN studying the condensation products of aldehyde Prof. Lieben has obtained (*Wied Akad. Ber.*) a new alcohol belonging to the same series as glycerin, viz. $C_4H_7(OH)_3$. The new compound, called butenyl glycerin by Lieben, is a syrupy, sweet-tasting liquid, soluble in water, boiling at 172°–175° under a pressure of 27 mm. It forms a triacetin analogous in properties to the natural fats, when heated with oxalic acid its behaviour is similar to that of glycerin: formic acid is produced along with an oily, strongly smelling substance which has not as yet been fully examined.

PHYSICAL NOTES

MONS A ANGOT proposes a new formula for calculating altitudes from barometric observations, based upon that given originally by Laplace. The existing method of calculation from observed monthly or annual means is found, as Plantamour has shown, to be defective, since its results exhibit an uncertainty that varies with the season, an elevated station appearing to be higher by day and in summer than at night or in winter. As an example, when the height of the Great St. Bernard is measured by comparison of barometer observations between that place and Geneva, it would appear that the height of the Great St. Bernard exhibits a diurnal variation of 17 metres in winter and of more than 47 metres in summer, while the mean of the June observations gives a height of 25 metres higher than that found from the January numbers! These anomalies M Angot explains by the facts that the mean temperature between the stations is not exactly equal to the half sum of the two temperatures, and that the weight of the air between the two stations is on the other hand greater when the mean temperature is low. The rather complicated formula proposed by M Angot gives the difference in altitude by calculating directly the height of each station above an imaginary plane at which the barometric pressure is equal to 760 millims. No empirical coefficients are needed in this case, the standard constants of Regnault and others for air and aqueous vapour being taken. M. Angot has recalculated from his formula a new set of tables, involving all the corrections that must be applied to the older tables of the Bureau des Longitudes.

IN a recent number of the *Journal de Genève* M Colladon has pointed out that a poplar or other tall tree may, if its roots strike into damp soil, serve as a lightning-conductor to protect a house, and he thinks he has verified this conjecture by examination of a number of individual cases of lightning-stroke. In the case however where the house stands between the tree and a piece of water, a pond or a stream, the shortest path for the lightning from the tree to the wet conductor may be through the house!

V VON ZOCH has described a new kind of electric dust-figures, which he regards as having an important bearing upon the theory of discharges in vacua, being in opposition to the views of Crookes. Tubes of 1 to 3 centims. diameter, and from 10 to 30 centims in length, were closed at both ends by corks pierced to receive copper wires. In the tubes were placed various powders, bronze powder being chiefly used in preference to others, which being lighter adhered to the sides of the tube. One wire was then connected with the positive conductor of an electric machine; from the other the repelled electricity dissipated itself into the air. In other cases the discharges of Leyden jars were employed. The experiments were all conducted at atmospheric pressure. When thus treated the bronze powder arranged itself in beautifully-marked ridges or strata, varying in regularity according to the original distribution of the powder. A space free from all traces of powder was observed to surround the positive pole. Usually there was a corresponding accumulation about the negative pole. These ridges or striations may be compared to the stratifications observable in Geissler tubes; and Herr Zoch shows that variations in the strength of the electric discharges, in the width of the tubes, &c., produce upon these figures similar effects to those they produce on the luminous striæ of vacuous tubes. In this present case a mechanical repulsion of the particles lying near the poles undoubtedly takes place, and the author of this research believes that the presence of light at the poles of the Geissler tube may be similarly accounted for on the hypothesis that the luminous regions are those of less density than the non luminous. Since the bronze powder is heaped up mostly about the negative pole the inference is that at the negative pole of a Geissler tube the residual gas has a greater density than at

any other part The stratifications produced by electric discharges through flames may be similarly explained; and these researches have an obvious bearing on the structure of Lichtenberg's well-known figures

MONS MERCADIER has been devoting some attention to the subject of the photophone, and more particularly to the production of sounds by the simpler forms of the instrument, in which a selenium receiver with its electrical connections is dispensed with The musical photophone—or, as M Mercadier chooses to style it, the radiophone—may be described as a sort of optical siren, in which a rotating disk pierced with holes is interposed in the path of a period of rays of light, causing intermittences of regular period varying with the speed of the disk Our readers will remember that such a beam falling on a simple disk of metal or of hard rubber throws it into vibration, and it emits a note corresponding in pitch with the frequency of the intermittences of the light In Prof Bell's actual instrument this "siren" was a heavy disk of brass pierced with holes M. Mercadier prefers a disk of black paper gummed upon a glass disk in order to get rid of the whistling sounds which even a gentle current of air produces on the brass disk It may be noted in passing that M Duboscq has independently constructed similar disks The receiving disks were fixed in a suitable holder at the end of a short india rubber hearing-tube M. Mercadier finds that when opaque disks of zinc, copper, and other substances are employed to receive the beams, very little difference in the loudness of the sounds can be perceived, whether the disks are polished or not. But the thickness of the disks is of great importance, thin ones answering much better than those a little thicker With transparent laminæ such as glass and quartz, M. Mercadier obtains strong effects, whereas Prof. Bell found only feeble results with these substances The degree of polish is here unimportant also; but a film of smoke or white paint, or of metallic silver on the front of the disk, diminishes its powers, while, on the contrary, the loudness is augmented by blackening the back of the disk M Mercadier employed as sources of light the lime-light and flames of petroleum fed with oxygen.

HERR F. KLOCKE has lately discovered an anomalous property in hyposulphite of lead in respect of its action on polarised light. This substance usually exhibits circularly polarised light but Klocke has found that plates cut perpendicularly to the optic axis, when viewed in the field of a polariscope by parallel rays of light, appear unequally bright, being divided by dark bands into six sectors, of which opposite pairs are equally bright In convergent light, moreover, the ordinary ring figure of a uniaxial crystal is not seen, but instead there appears in each sector a figure of the form characteristic of the ordinary biaxial crystal, and having the plane of the optic axes perpendicular to the neighbouring edge of the crystal The explanation of this curious phenomenon appears to be that there is some anomaly in the molecular structure of the crystals, by virtue of which the six portions are compressed equally each in direction perpendicular to the neighbouring face of the prism.

IN the Vienna *Berichte* for June, 1880, Victor von Lang describes a form of dichroiscope, in which a small improvement upon the common form has been made Usually the small square aperture through which light is admitted to the rhomb of spar is fixed rigidly to the tubular holder of the latter In the new form the square aperture is cut in a diaphragm fastened to an outer tube, which can be rotated round the inner The advantages gained in permitting the rhomb of spar to be turned independently of the aperture are obvious. A plano-convex lens of small magnifying power is added as usual as an eyepiece at the other end of the rhomb.

M. AMAGAT has experimented on the compressibility of oxygen gas in an apparatus in which the working fluid for transmitting the pressure was mercury. Since the experiments of Regnault it has been commonly assumed that the absorption of the gas by mercury at high pressures and temperatures rendered inexact any such experiments. M. Amagat however finds that the absorption is almost insensible, an oxygen manometer and a nitrogen manometer giving identical indications for several days, even with temperatures varying up to 100°.

MM HAUTEFEUILLE AND CHAPPUIS have continued their researches on the liquefaction of ozone, which they have lately liquefied in the presence of carbonic acid. They believe the point of liquefaction of ozone to be very near that of carbonic acid, and on mixing ozonised oxygen with carbonic acid and submitting it in a capillary tube to a slow pressure at a temperature of $-23°$ (obtained by the evaporation of methylic chloride), they obtained a liquid separated by a distinct meniscus from the gas This liquid was of a clear blue tint, as was the compressed gas above it. If the substance is then allowed to expand gently and immediately compressed, the liquid becomes much more blue, owing to the greater proportion of liquefied ozone The blue tint thus characteristic of ozone under pressure proves it to be present in the gases which result when the silent electric discharge is passed through carbonic acid gas for some hours

EDISON has lately patented a "*webermeter*." This is an instrument for measuring the amount of electric current flowing through a circuit, or in other words a *meter* for electric currents to tell the number of webers that have been supplied. The name is at least in accordance with the inventor's usual abundant ingenuity

IN the *Comptes rendus* M Gouy publishes an extract from a memoir presented by him to the Académie des Sciences, on the propagation of light In this memoir he proposes to examine the particular case of propagation of luminiferous waves, in which, while the direction of the propagation of the movement is constant, the intensity of the waves or of the source of light varies. This problem, which has doubtless been suggested to the author by considerations derived from the photophone, affects the whole question of the measurement of the velocity of light, whether by the methods of occultations of Rœmer and Fizeau, or by that of aberrations (in the rotating mirror), as devised by Foucault The former case only is treated of in M Gouy's paper Setting aside at first the case of dispersive media, and restricting the question to isotropic media, M Gouy investigates mathematically whether the velocity of propagation of the amplitude is the same as that of the wave, and finds that this is the case only for those waves for which the differential equations contain no terms beyond those of the second order—those in which the vibration has virtually attained to the steady condition For such waves moreover in dispersive media the amplitude is not propagated with the same velocity as the waves themselves, but the amplitude itself varies according to a complex function of the wave length according to an ascertainable periodic law. If we remember rightly, a similar hydrodynamic investigation of the rate of propagation of waves in water was made some years ago by Prof Osborne Reynolds, with the result that the effective wave-front only travelled at half the velocity of the steady waves The inference is that that which physicists usually term "the velocity of light" is only the rate of propagation of the wave front, which is slower than the true velocity, the retardation being greatest for the vibrations of greatest wave-length

ANOTHER new property of selenium is claimed as the discovery of M. Blondlot. He states that when selenium is rubbed upon platinum, each metal being connected with a terminal of a capillary electrometer, a current is observed This current, which is observed to pass through the electrometer from the platinum to the selenium, appears therefore to differ from the tribo-electric currents discovered by Becquerel, and which were always in the same direction as the thermo electric currents which would have been produced had the surfaces of friction been directly heated The true thermo electric current of a selenium platinum pair is, according to M Blondlot, from selenium to platinum through the heated junction One curious point stated by M Blondlot is that no indication whatever is obtained upon the capillary electrometer by friction between two metals, or between two insulators, or between a metal and an insulator The electrometer in the selenium experiment indicated a difference of potential about equal to that of one Daniell's cell.

MAGNUS AND TYNDALL found carbonic acid to have a considerable absorbent action on radiant heat. Dr Lecher (*Wien Acad Anz*) has lately made new observations, especially as to absorption of solar radiation by the carbonic acid in the atmosphere. Experiments with a gas lamp and glass cylinder first showed that carbonic acid in a length of 214 mm. gave passage to 94·8 per cent. of the radiation, 536 mm 93·8 per cent , 917 mm 89·0 per cent. At Greifenstein, outside of Vienna (chosen for pure air), the sun's rays also were proved to undergo considerable weakening in passage through carbonic acid gas. A layer of this gas one metre thick absorbed about 13 per cent when the sun had an altitude of 59°, the number however diminished in proportion as the sun got lower This shows that the absorption of solar radiation by carbonic acid is selective, and that the

absorbable wave-lengths become more rare the greater the atmospheric layer the rays have already traversed. The author calculates from his experiments the proportion of carbonic acid in the atmosphere, finding it 3·27 in 10,000 parts by volume; a number agreeing so well with results of chemical analysis as to indicate that this is a good way of determining the carbonic acid in the atmosphere and its variations, applicable, too, at heights where direct measurements are impossible

HERR WINKELMANN proves by experiment (*Wied Ann* No. 11) that the heat conduction of ethylene decreases somewhat with increased pressure The pressure was varied from 10 to 740 mm (Comparative experiments with air showed no influence of pressure) The author explains the phenomenon by the divergence of ethylene from Boyle's law The action of cohesion-forces between the molecules is indicated by that fact, and this will cause, at each collision, a temporary retardation of the straight movements, which effect will occur oftener the greater the number of collisions (*i e* the greater the density) Hence this retardation will increasingly affect the velocity with which two contiguous layers of different temperature exchange the energy of their motions

A REMARKABLE fall of rain in Austria and neighbouring parts on August 11-15 this year, has been closely investigated by Dr Hann (*Wien. Akad. Anz.*), on the basis of data from 260 stations in Austria-Hungary, Bavaria, Switzerland, and Saxony. This fall caused the Danube at Vienna to reach (on the 18th) its highest summer level in this century The rain began in Siebenburgen and south-east Hungary on the 11th, and in general went from east to west It was most extensive on the 12th, and the heaviest fall was in Salzkammergut and neighbourhood The rain-area is found to lie on the west and north-west side of the area of lowest air-pressure, and to stretch westwards far over the border of the minimum region Near the centre of lowest pressure the precipitation was much less than in several parts distant from it The non existence of a minimum producing power of rainfall (contrary to common views), and the incapability of so great rainfall as that in the present case attracting a minimum and influencing its propagation, are noteworthy. The general conclusion arrived at is that no relation is demonstrable between barometric variation and rainfall; the fall of the barometer does not primarily depend on the rainfall, and is not perceptibly influenced by it Dr Hann finds this confirmed by an examination of several other heavy rainfalls in their relation to distribution of air-pressure

THE salt and the ice in cryohydrates have been regarded by Prof Guthrie as in chemical combination In 1877 Herr Pfaundler expressed the view that cryohydrates were merely mixtures of salt and ice. This view is also maintained by Herr Offer, who in a recent paper to the Vienna Academy raises various objections to the existence of cryohydrates as chemical compounds. The numbers expressing the quantities in which the water unites with the salts in various cryohydrates, indicate no stoichiometric law, and tell much rather in favour of chemical mixtures No cryohydrate forms a clear and pure crystal, but always an opaque confused crystalline mass The phenomena which occur when cryohydrates are brought into alcohol and into water are considered to be against Prof. Guthrie's view The heat-absorption of cryohydrates in dissolving, as compared with that of the salt and ice separately, only presents differences which lie within the errors of observation Further, Herr Offer compared the specific gravity of several cryohydrates with those of their constituents, and found pretty close agreement.

FROM recent magnetic researches Herr Auerbach (*Wied Ann.* No. 11) finds the temporary magnetism of cylindrical bodies, *ceteris paribus*, proportional to the mass, greater the greater the length, the less the thickness, the greater the density, dependent only on form, not on size, in the case of nickel, according to density and force, a quarter to half as much as in iron. It increases with magnetising force, first proportionally, then (except with very small density) more quickly, and at last more slowly. The quick increase is greater the denser the body. The turning point is, for the same density, at the same place, but with stronger forces the greater the density, for magnetic saturation of powders extremely strong forces are necessary. Herr Auerbach theorises on these results.

ANOTHER paper on magnetism in these *Annalen* is by Herr Baur, and deals with the "function of magnetisation" for very small magnetising forces; the influence of temperature on it; the magnetisability of iron at very high temperatures; Gore's phenomenon, and the function for varieties of iron. Among other results, the smaller the magnetising force the greater is the influence of temperature on the function in question. Up to a certain force the function increases with increase in temperature, but beyond that it decreases. With weak forces the temporary magnetic moment rises quickly (with rise of temperature) to a maximum at red glow, then sinks quickly to *nil*, with strong forces it gradually sinks, with rise of temperature, to a very low value at red glow. With increased magnetic force Gore's phenomenon becomes more intense and prolonged, and it occurs at a higher glow In ordinary iron the function of magnetisation reaches its maximum very quickly, in iron filings later, and in electrolytic iron very late.

GEOGRAPHICAL NOTES

THE glacier of the Byeloukher Mountain, the chief summit of the Siberian or Great Altay, which has not been visited by men of science during the last fifty years, was recently explored by an expedition engaged in the study of the life of the West Siberian natives After having crossed the 9000 feet high Alps of the Tchouya, the explorers descended into the pretty and wealthy broad valley of the Tchouya, whence, following the Arkhyt River, they soon reached the foot of the mighty Berel glacier The glacier, which forms in its lower parts a *mer de glace* two miles long and 2800 feet wide, was accurately explored and surveyed during a week by the expedition from its lower end to a great ice fall, where the travellers were compelled to stop their work before a moving wall of ice, while mighty masses of snow fell, one after the other, on the glacier from the neighbouring mountains. After having surveyed the glacier and made several drawings of the severe scenery which it affords, the travellers returned to the valley of Ouimon, and thence to the civilised towns

THE astronomical determinations of positions which were made by M Pyevtsoff during his journey from Khobdo through Mongolia to Kalgan, and from Ourga to Kosh agatch, are published by Col Scharnhorst in the last number of the *Izvestia* of the Russian Geographical Society They are most welcome, as they come from a country where exact determinations are very scanty. —The same fascicule of the *Izvestia* contains M. Larionoff's catalogue of seventy-five determinations of heights in the northern and eastern parts of the province of Kouldja and in the mountains which border it north and ea t, and M Severtsoff's map of his route on the Pamir Rang-koul, south-east of the Lake Kara-koul.

THE Russian travellers who have been engaged in the exploration of Central Asia are now returning to St Petersburg Col. Prshevalsky is expected every day, and the Russian Geographical Society, at its last meeting (December 15), elected the indefatigable traveller an Honorary Member M Potanin is already at St. Petersburg, and will soon give a lecture on his journey to Western Mongolia, as also M Pyevtsoff, who travelled with merchants from Biysk to Khou-khou khoto, and who during his journey collected much material for the correction of the map of Mongolia M Mushketoff, who has explored the glacier of Zarafshan (NATURE, vol xxiii p 44), gave a lecture at the last meeting of the Russian Geographical Society on his excursion. This traveller, contrary to M. Severtsoff's experience, did not find in the Thian-Shan any traces of the glacial period

THE *Kouban News* announces the appearance, in the Sea of Azoff, of a new little island, some 150 feet in diameter, and 10 feet above the level of the water Its appearance was accompanied with a kind of marine eruption. It is 150 brasses distant from the shore, where a crevice has appeared.

THE organisation of the Polar meteorological station on the Lena is being actively carried out by Prof. Lentz The director of the station will be M Yurgens.

PROF. NORDENSKJOLD is again thinking of fresh enterprises. At present a ship is being built at the Lena estuary, in which he intends to start on a new Arctic expedition in the summer of 1882

PRINCE BORGHESE, the Italian African traveller, has arrived near Tripolis from Wadai. This is the first time that a traveller from Darfur has reached the Mediterranean by way of Wadai and Bornu.

THE Leipzig publishing firm of Ferd Hirt and Son announce that Major Serpa Pinto's great African work of travel will be published in January, 1881.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

ALFRED C. HADDON, B.A., Scholar of Christ's College, Demonstrator of Comparative Anatomy, and Curator of Zoology in the University of Cambridge, has been appointed Professor of Zoology at the Royal College of Science, Dublin.

THE movement to found a college at Dundee has been revived, and at a meeting last week it was announced by Dr. Baxter, the Procurator Fiscal, that he was in a position to place 125,000*l.* at the head of a subscription for the purpose. Owens College, Manchester, is proposed as the model of the Dundee Institution.

DURING recent years much has been done in Russia by private initiative for primary education in natural science. Now we notice the creation at St. Petersburg of a special institution, the aim of which is to devise and collect apparatus and drawings for the teaching of natural science in primary schools. A special collection of objects intended for the illustration of science will be sent from school to school by the Committee, and lectures will be given in each school on the subject.

THE building of the new Siberian University is being briskly carried on. It will contain twenty large rooms for lectures, as well as spacious halls for the museum and library. The building for anatomy, as well as the hospital for clinical medicine, will be erected in accordance with the latest hygienic principles. A special building will be appropriated for the physical cabinet and the astronomical observatory.

THE Moscow University is closed for an indeterminate time because of the disturbances among medical students, and three hundred students are incarcerated in the town prison.

SCIENTIFIC SERIALS

Journal of the Franklin Institute, December.—Boiler experiments, by Mr. Isherwood.—New electric motor, by Mr. Griscom.—The Sawyer electric light.—Proceedings of Institute, &c.

Bulletin de l'Académie Royale des Sciences de Belgique, Nos. 9 and 10.—Influence of liquids on the sound of sonorous bells which contain them or which are immersed in them, by M. Montigny.—On the chemical composition of the epidote of Quenast, by M. Renard.—On Caels and De Bennie, by M. Mailly.

No. 11.—On the compensation of a chain of geodetic triangles, by M. Adan.—Excretory apparatus of Trematodes and Cestodes (3rd paper), by M. Fraipont.

Rivista Scientifico Industriale, No. 21, November 15.—On spherohedry in crystallisation, by Prof. Bombicci.—On beats, the third sound of Tartini, &c. (concluded), by Dr. Crotti.

No. 22, November 30.—On some singular phenomena of geometrical optics, by Prof. Cassani.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti, vol. xiii. fasc. xvii., November 11.—On *Peronospora viticola* and the cryptogamic laboratory, by Prof. Garovaglio.—On measurement of the thermo-luminous radiations of the sun, by Dr. Chistoni.—Fourth series of researches and studies on the pelagic fauna of the Italian lakes (short *résumé*), by Prof. Pavesi.—The leprosy of Ancient Italy, especially of Comacchio, by Prof. Sangalli.

Kosmos, September 1880, contains:—Theodor Vuy, on the rehabilitation of shattered authorities; considerations on the education of the future.—Dr. Ernst Krause, sketch of the development history of the history of development, No. 3.—Dr. H. Muller, on the variability of alpine flowers.—Leopold Einstein, apprehension and comprehension, a study in the philosophy of language.—Short notices and extracts from journals. Literary and critical notices.

October.—Prof. Fritz Schultze, the transformation of human fundamental conceptions on the threshold of modern times.—Prof. Dr. Hornes, on phacops and dalmanites, genera of trilobites and their probable genetic connection.—George Potonié, on the purport of the stony particles to be found in the flesh of the pear and generally in the Pomaceæ.—Dr. Fritz Muller, *Paltostoma torrentium*, a gnat with two forms of females, one with a mouth for honey-sucking the other with a mouth for blood-sucking (with illustration).—Short notices and extracts from journals. Literary and critical notices.

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, December 16.—Prof. H. E. Roscoe, president, in the chair.—The following communications, &c., were made:—On the estimation of nitrogen by combustion, including the nitro-compounds, by J. Rufile. The author recommends the use of the following mixture instead of soda lime in the process of Will and Varrentrapp:—Two molecules of sodium hydrate, one molecule of pure lime, and one molecule of sodium hyposulphite, the substance before burning being mixed with about its own weight of a mixture of sulphur and wood charcoal. By this process good results were obtained with sodium nitrate, picric acid, &c.—Dr. Carnelly then showed some experiments as to the effect of pressure in raising the melting-points of ice, camphor, and mercuric chloride. By suspending a cylinder of ice (formed round the bulb of a thermometer) in a Torricellian vacuum and condensing the aqueous vapour by a freezing mixture, so as to keep the vacuum perfect, the author has raised ice to 180° C. before it melted. In the experiment shown, through an accident, the temperature only rose to 30° C. before the cylinder fell off the thermometer. Camphor which was boiling in a tube solidified when the pressure was diminished, though the heating was continued. Mercuric chloride, which under diminished pressure had been raised considerably above its melting-point, melted and boiled as soon as it was exposed to atmospheric pressure.—On some naphthalene derivatives, by Dr. Armstrong and Mr. Graham.

Geological Society, December 15.—Robert Etheridge, F.R.S., president, in the chair.—William Elijah Benton, Rev. George Clements, J. Kerr Gulland, Francis T. S. Houghton, George Bingley Lake, and William Mansell MacCulloch, M.D., were elected Fellows, and Prof. Luigi Bellardi of Turin, and Dr. M. Neumayr of Vienna, Foreign Correspondents of the Society. The following communications were read:—On the constitution and history of grits and sandstones, by John Arthur Phillips, F.G.S. In the first part of this paper the author described the microscopic and chemical structure of a large series of grits, sandstones, and in some cases quartzites, of various geological ages, noticing finally several sands of more or less recent date. The cementing material in the harder varieties is commonly, to a large extent, siliceous. The grains vary considerably in form and in the nature of their inclosures, cavities of various kinds and minute crystals of schorl or rutile not being rare. The author drew attention to the evidence of the deposition of secondary quartz upon the original grains, so as to continue its crystal structure, which sometimes exhibits externally a crystal form. This is frequently observable in sandstone of Carboniferous, Permian, and Triassic age. Felspar grains are not unfrequently present, with scales of mica and minute chlorite and epidote. Chemical analyses of some varieties were also given. The author then considered the effect of flowing water upon transported particles of sand or gravel. It results from his investigations that fragments of quartz or schorl less than one fiftieth of an inch in diameter retain their angularity for a very long period indeed, remaining, under ordinary circumstances, unrounded; but they are much more rapidly rounded by the action of wind. It is thus probable that rounded grains of this kind in some of the older rocks, as, for example, certain of the Triassic sandstones, may be the result of Æolian action.—The chair was then taken by J. W. Hulke, F.R.S., V.P.G.S.—On a new species of *Trigonia* from the Purbeck beds of the Vale of Wardour, by R. Etheridge, F.R.S., president, with a note on the stratigraphical position of the fossil by the Rev. W. R. Andrews. In this paper the author described a species of *Trigonia* discovered by the Rev. W. R. Andrews in the "under-bed" of the Middle Purbeck series in the Vale of Wardour. The specimens were found in the railway-cutting one mile west of Dinton Station. The shell was referred to d'Orbigny's section "Glabræ" of the genus *Trigonia*, and named *Trigonia densinoda*. In its ornamentation it closely resembles *T. tenuitexta*, Lyc., of the Portland oolite, but is more depressed and lengthened posteriorly, and destitute of the antecarinal space which occurs in all known Jurassic "Glabræ." The escutcheon is remarkably large, and possesses transverse rugæ, as in the Neocomian "Quadratæ." The author regarded the species as a transition form connecting the two groups of *Trigoniæ* above-mentioned. The description of the new species was accompanied by a note on the Purbeck strata of the Vale of Wardour by the Rev. W. R. Andrews.

Meteorological Society, December 15.—Mr. G. J. Symons, F.R.S., president, in the chair.—J. Coventry, J. W. Moore,

M.D, W. T. Paulin, J. Porter, and Capt. W. C Smith were elected Fellows —The following papers were read —Report on the phenological observations for the year 1880, by the Rev T. A Preston, M.A., F M.S Agriculturally speaking the year may be considered as disappointing Till June the weather was such as has rarely been experienced for farm operations. The severe cold of the winter broke up and mellowed the soil, and the dry open weather enabled farmers to clean their land from the excessive growth of weeds caused by the damp of the year before The dry May was not favourable for the hay, which suffered severely in some places, but still a crop with far more real nourishment in it than would be obtained from a rank growth would have been secured had it not been for the terrible floods of July in the Midland Counties, which not only seriously injured the crop, so that it was frequently not worth the trouble of removing off the land, but also carried it entirely away in low-lying districts The corn again, which was looking most promising till July, suffered much during that damp period, and had it not been for the subsequent fine weather would have been ruined. But the unfavourable season of 1879 produced very serious effects on vegetation, especially on trees and shrubs and their produce. The young wood of the trees was not ripened, and as a natural consequence the severe winter killed an enormous quantity of some kinds, and greatly injured others "Laurustinus" was generally killed to the ground, and in some districts the destruction of other shrubs was severely felt. The evergreens in many cases lost large quantities of their leaves. Hollies especially are mentioned by several observers, and privet-hedges were sometimes quite leafless With respect to fruit-trees, apples and pears in some localities (but not all) were hardly able to put forth any bloom, and the crops were consequently extremely poor Wall-fruit was also a general failure, but this was partially owing to severe weather when the trees were in bloom, for in some instances the show of bloom was splendid Gooseberries and currants produced enormous crops, and strawberries were very fine, but they lasted an unusually short time Seeds generally ripened with difficulty; much of the corn could not be ground, and a great deal was mixed up with roughly-ground Indian corn and flavoured to induce the cattle to eat it. The crop of ordinary garden seeds was also far below its usual quality, and some of the favourite garden flowers were consequently very poor Among the *special* features of the year may be mentioned the great quantity of certain insects "Aphis" was in astonishing numbers in the early part of the year The apple-shoots, before the leaves expanded, were in almost every case covered with the "green fly," and among wild plants the Mealy Guelder-rose was especially attacked by them. "Wasps," again, have been in extraordinary numbers, and dreadful accounts of them have been sent to the various entomological periodicals, their numbers appear to have exceeded all previous experience The larvæ of the gooseberry moth and of the gooseberry saw-fly have also been extremely destructive, and finally, as an undoubted result of the wet season of 1879, the larvæ of the crane fly have been a perfect plague in some localities, and sheep licks in others. The scarcity of small birds has been universally noticed, some, no doubt, perished from the cold, but vast numbers had migrated The enormous numbers of larks which hastened to the Eastern Counties on the outbreak of cold weather was astonishing.—On the variations of relative humidity and thermometric dryness of the air, with changes of barometric pressure at the Kew Observatory, by G M. Whipple, B.Sc, F.R.A S —On the relative frequency of given heights of the barometer readings at the Kew Observatory during the ten years 1870-79, by G M Whipple, B Sc, F R.A.S.

Mineralogical Society of Great Britain and Ireland, December 23 —Prof M. Forster Heddle, F.R S E, president, in the chair —Prof. F. J Wiik of Helsingfors was elected a corresponding member, and Messrs Baxter, Gray, James Cunningham, R. Shaw Simpson, H. B Guppy, and Stephen Vivian as ordinary members —The following papers were read and discussed:—On Tyreeite, by the President.—On minerals new to Britain, by the President —Note on Gilbertite, and on tin pseudomorphs from Belowda Mine, by J. H Collins.—On Brochantite and its allies, by William Lemmons —On a remarkably fine crystal of Euclase, by L. Guyot —On the action of organic acids on minerals, by Prof. H. C Bolton —Note on artificial Gay-Lussite, by C Rammelsberg —Note on a peculiar carbonaceous substance from the Maesymarchog Colliery, by James S. Merry.

Anthropological Institute, December 14.—Edward B. Tylor, F R.S, president, in the chair.—The election of the Rev R A. Bullen as a member of the Institute was announced. —Mr W. St Chad Boscawen read a paper on "Hittite Civilisation"

Institution of Civil Engineers, December 21.—W. H. Barlow, F R S., president, in the chair —The scrutineers reported that the following gentlemen had been duly elected to fill the several offices in the Council for the ensuing year.—Mr. James Abernethy, president; Sir W G Armstrong, C B, F R.S, Sir J W. Bazalgette, C B, Mr. F. J Bramwell, F R S., and Mr J. Brunlees, vice-presidents; Mr. G. Berkley, Mr. G B Bruce, Sir John Coode, Mr. E. A. Cowper, Mr. A. Giles, Sir Charles A. Hartley, Mr. H. Hayter, Dr W. Pole, F.R S, Mr R Rawlinson, C B, Mr. A. M Rendel, Dr. C. W. Siemens, F R.S, Mr D Stevenson, Sir W Thomson, F R.S., Sir Joseph Whitworth, Bart, F.R.S., and Mr. E Woods, other members of Council.

EDINBURGH

Royal Society, December 20 —Sir Wyville Thomson, vice-president, in the chair —Mr John Aitken read a paper on dust, fogs, and clouds, which we give on another page. —Mr E Sang communicated a note on the solar eclipse of December 31, 1880, which is visible in our islands.—Dr Marsden, in a paper on the preparation of adamantine carbon, intimated that he had at length effected the crystallisation of carbon in the cubical form The crystals he had obtained were however far too minute to be of any commercial value —Prof Blyth described an electric sonometer, consisting of a wire monochord, which, traversed by an interrupted electric current, was set into strong vibrations between the poles of a horse shoe magnet. The notes given out were loudest when they were harmonics of the fundamental interrupted note which was sounded by a vibrating tuning-fork inserted in the circuit—Dr Haycraft communicated an explanation of the amœboid motions of masses of protoplasm, illustrating his theory by an extremely simple mechanical contrivance An india rubber ball perforated with several small apertures was filled with coloured white of egg, and immersed in a solution of sugar of about the same density as the albumen When a gentle pressure was applied, the albumen was forced out in long continuous processes, and when the pressure was relaxed the processes at once retracted inside the ball again, probably in virtue of the action of the viscosity and surface-tension of the gelatinous matter Thus was explained the retraction of the amœboid processes, after they had been expelled by contraction of the internal muscular structure.

CONTENTS

THURSDAY, JANUARY 6, 1881

DR. GUNTHER ON FISHES

An Introduction to the Study of Fishes. By Albert C L G Gunther, M A, M D, Ph D, F R S, Keeper of the Zoological Department in the British Museum (Edinburgh, A and C Black, 1880)

A GENERAL work on Fishes could not have been undertaken by a more thoroughly qualified writer than Dr Gunther Twenty years ago and more he commenced studying the collection of this ever-interesting and most important group in the vaults of the British Museum, with what success let not only the present fine collection of fish in the National Museum declare, but also that truly wonderful work, to be the product of one man's labours, "The Catalogue of Fishes," in eight volumes, published by order of the Trustees of the British Museum Fishes have always been a subject of great interest to mankind, their commercial value interests some, others, as keen sportsmen, could not exist without their finny prey, from the earliest times, and among the earliest records, we find them of importance as articles of food To the man of science, be he or be he not a specialist, fishes are of an ever-increasing interest, placed at the very beginning of vertebrate life, and by their study we seem to see more clearly into the evolution of that life which culminated in the production of ourselves

A book to tell us in carefully selected generalities all about fishes such the English reader had no access to, until the publication of this volume If it come not up to a perfect standard how could it be otherwise, for had not the history of the structure of fish, their habits, their distribution, their classification to be condensed within the limit of a few hundred pages, and the wonder is that so much will be found here given, not that a few things have been left unnoticed or but partially touched upon We have looked over each page of the handsomely got-up, well-printed, and well-illustrated volume, and we feel certain that it must find a place on the shelf of all biologists, and that it will find a place in the libraries also of that vastly larger class, the intelligent general reader

The first and slightly smaller half of the volume treats of fishes in general, the second half of fishes from a systematic and descriptive point of view The work opens with an account of the history and literature of the subject beginning with Aristotle, who had a perfect knowledge of the general structure of fish, and who wrote about them some three and a half centuries before the Christian era, which account is continued to the most recent times, the work done by Ray, Artedi, Linneus, Bloch, Lacépède, Cuvier, Agassiz, Muller, being passed in review The next twelve chapters treat of the external morphology of fish and of their internal structure. We would have liked more details about the recent researches into the modifications to be met with in fishes' tails; the description of the electrical organs to be met with in some fish is far too brief, the myology of fishes is dismissed with a little over a page, as if it were not a favourite subject with the author, and yet it is one worth working at and by no means deficient in promise In the chapter on Respiration the subject of the temperature in fishes is scarcely alluded to; the chapter on the Reproductive Instincts of Fish is sure to interest the readers, some of whom may learn for the first time of female fishes taking care of their progeny, and more curious, of male fishes doing the same The chapter on the Growth and Variation of Fishes is well illustrated by woodcuts of some remarkable changes of form in fish The fourteenth chapter treats of domesticated and acclimatised fishes, on the artificial impregnation of ova, tenacity of life and reproduction of lost parts, hybernation in fishes (a misuse of this term), useful and poisonous fishes The uses of fishes to man our author disposes of in twelve lines, and it would almost seem as if he would rather not have referred to such a subject at all in the scientific part of this treatise In these twelve lines we find the following - "In the Polar regions *especially* whole tribes are *entirely* dependent on this class for subsistence" Without venturing on criticism we would ask, Is this so? Do the inhabitants of the Polar regions support their life wholly on fish, or are they not indebted for a large portion of their heat-producing food to the flesh or blubber of mammals? and do not the inhabitants of tropical countries, on the contrary, manage often to support their existence almost entirely on fish food?

While the chapters concerning the distribution of fishes in time leave a good deal to be desired, those on the distribution of fishes in space are most excellent, that on the fishes of the deep sea contains a complete list of deep-sea forms with the depths as ascertained by the dredgings of the *Challenger*, which list contains apparently over 100 species. Before the voyage of the *Challenger* scarcely thirty deep-sea fishes were known Though this number has been now so very much increased yet no new types of families have been discovered Perfectly novel and very interesting modifications of certain organs have been met with, but nothing more than what might have been expected from our previous knowledge of the group The greatest depth reached hitherto by a dredge in which fishes were inclosed is 2900 fathoms, but the specimens then obtained belong to a species (*Gonostoma microdon*), which would seem to be extremely abundant in the upper strata of the Atlantic and Pacific Oceans and were very probably caught by the dredge in its ascent The next greatest depth, 2750 fathoms, must be accepted as one at which fishes undoubtedly do live The fish obtained at this depth in the Atlantic, *Bathyophis ferox*, showing by its whole habit that it is a form living on the bottom of the ocean

"The fish fauna of the deep sea," writes Dr Gunther, "is composed chiefly of forms or modifications of forms which we find represented at the surface in the cold or temperate zones, or which appear as nocturnal pelagic forms" The Chondropterygians are few in number, not descending to a depth of more than 600 fathoms The Acanthopterygians, which form the majority of the coast and surface faunas, are also scantily represented; genera identical with surface types are confined to the same inconsiderable depths as the Chondropterygians, while those Acanthopterygians which are so much specialised for the life in the deep sea as to deserve generic separation, range from 200 to 2400 fathoms Three distinct families belong to the deep sea fauna, viz Trachypteridæ, Lophotidæ, and Notacanthidæ, they

respectively consist of three, one, and two genera. Gadidæ, Ophidiidæ, and Macruridæ are very numerous, ranging through all depths, they constitute about one-fourth of the whole deep-sea fauna. Of Physostomi, the families of Sternoptychidæ, Scopelidæ, Stomiatidæ, Salmonidæ, Bathythrissidæ, Alepocephalidæ, Halosauridæ, and Muræmidæ are represented. Of these the Scopeloids are the most numerous, constituting nearly another fourth of the fauna. Salmonidæ are scarce, with three small genera only Bathythrissidæ includes one species only, which is probably confined in its vertical as well as horizontal range, it (*Bathythrissa dorsalis*) occurs at a depth of about 350 fathoms in the sea of Japan The Alepocephalidæ and Halosauridæ, known before the *Challenger* Expedition from isolated examples only, prove to be true, widely spread, deep-sea types Eels are well represented, and seem to descend to the greatest depths; Myxine has been obtained from a depth of 345 fathoms

In the systematic portion Dr Gunther divides the class of fishes into four sub-classes the first Palæichthyes, the second Teleostei, the third Cyclostomata, and the fourth Leptocardii The description of each order, sub-order, and family is given In addition we have the diagnosis of all the more important genera, and under these are given the names of the species of economic value or special scientific interest. We select the following account of two interesting genera as examples taken from the eighth family of the sharks, Spinacidæ —

"ACANTHIAS—Each dorsal fin with a spine Teeth equal in both jaws, rather small; their point is so much turned aside that the inner margin of the tooth forms the cutting edge Spiracles rather wide, immediately behind the eye

"The two species of 'Spiny Dog Fishes,' *A vulgaris* and *A Blainvillii*, have a very remarkable distribution, being found in the temperate seas of the Northern and Southern Hemispheres, but not in the intermediate tropical zone They are of small size, but occur at times in incredible numbers, as many as 20,000 having been taken in one season on the Cornish coast They do much injury to the fishermen by cutting their lines and carrying off their hooks

"CENTROPHORUS—Each dorsal fin with a spine, which however is sometimes so small as to be hidden below the skin, mouth wide, teeth of the lower jaw with the point more or less inclined backwards and outwards, upper teeth erect, triangular, or narrow, lanceolate with a single cusp, spiracles wide, behind the eye.

"Eight species are known from the southern parts of the European seas and one from the Moluccas, they do not appear to exceed a length of five feet According to the observations of E. P Wright some of the species at least live at a considerable depth, perhaps at a greater depth than any of the other known sharks. The Portuguese fishermen fish for them in 400 to 500 fathoms with a line of some 600 fathoms in length The sharks caught were specimens of *Centrophorus cælolepis*, from three to four feet long, the sharks as they were hauled into the boat fell down into it like so many dead pigs, there was not the smallest motion of their bodies. There can be no reasonable doubt that they were inhabitants of the same great depth as Hyalonema, and that in fact they were killed by being dragged to the surface from the pressure of water under which they lived The dermal productions of some of the species have a very peculiar form, being leaf-shaped, pedunculate, or ribbed or fronded with an impression."

One other quotation must suffice; the Clupeidæ forms the twenty-second family of the Physostomii, which is the fourth order of the second sub-class; after enumerating several genera, among them Engraulis, to which the Anchovy belongs, the hint being given that "lucrative fisheries of Anchovies might be established in Tasmania, where the same species occurs, in Chili, China, Japan, California, at Buenos Ayres, each of which countries possesses Anchovies by no means inferior to the Mediterranean species," the author proceeds to give the particulars of the genus Clapea. After the scientific description he adds —

"This genus comprises more than sixty different species The majority are of greater or less utility to man, but a few tropical species (*C thrissa*, *C. venenosa*, and others) acquire probably from their food highly poisonous properties so as to endanger the life of persons eating them The most noteworthy species are —

"1 *C harengus* (the 'Herring') It is readily recognised by having an ovate patch of very small teeth on the vomer. Gill cover smooth without radiating ridges It inhabits in incredible numbers the German Ocean, the northern parts of the Atlantic, and the seas north of Asia. The herring of the Atlantic coasts of North America is identical with that of Europe A second species has been supposed to exist on the British coast (*C Leachii*), but it comprises only individuals of a smaller size, the produce of a late or early spawn. Also the so-called 'Whitebait' is not a distinct species, but consists chiefly of the fry or the young of herrings, and is obtained 'in perfection' at localities where these small fishes find an abundance of food, as in the estuary of the Thames

"2 *C mirabilis* The herring of the North Pacific

"3. *C sprattus* The 'sprat,' without vomerine teeth. Gill cover smooth, without radiating ridges. Abundant on the Atlantic coasts of Europe

"4 *C. thrissa* One of the most common West Indian fishes, distinguished by the last dorsal ray being prolonged into a filament Hyrtl has discovered a small accessory branchial organ in this species

"5. *C. alosa* The 'shad' or 'Allice shad,' with very fine and long gill-rakers, from sixty to eighty on the horizontal part of the outer branchial arch, and with one or more black lateral blotches Coasts of Europe, ascending rivers

"6 *C finta* The 'shad' or 'Twaite shad,' with stout osseous gill-rakers from twenty one to twenty-seven on the horizontal part of the outer branchial arch, and spotted like the preceding species Coasts of Europe, ascending rivers and found in abundance in the Nile

"7. *C menhaden* The 'mossbanker,' common on the Atlantic coasts of the United States The economic value of this fish is surpassed in America only by that of the Gadoids, and is derived chiefly from its use as bait for other fishes and from the oil extracted from it, the annual yield of the latter exceeding that of the whale (from American fisheries). The refuse of the oil factories supplies a material of much value for artificial manures.

"8 *C sapidissima* The American shad, abundant and an important food-fish on the Atlantic coasts of North America. Spawns in fresh water

"9 *C. mattowocca* The 'Gaspereau' or 'Ale-wife,' common on the Atlantic coasts of North America, ascending into fresh water in early spring and spawning in ponds and lakes

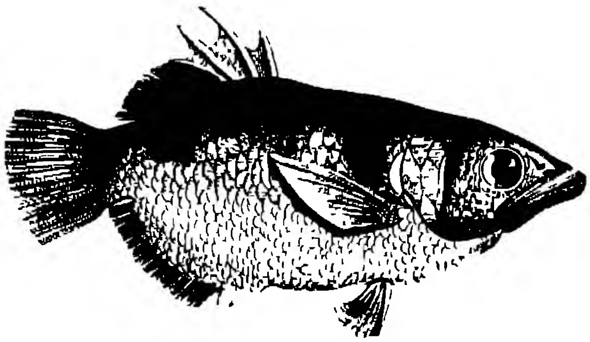
"10 *C pilchardus*. The 'Pilchard' or the 'Sardine,' equally abundant in the British Channel, on the coast of Portugal, and in the Mediterranean, and readily recognised by radiating ridges on the operculum, descending towards the sub-operculum

"11 *C sagax* Representing the Pilchard in the Pacific, and found in equally large shoals on the coasts of California, Chili, New Zealand, and Japan.

"12. *C. toli.* The subject of a very extensive fishery on the coast of Sumatra for the sake of its roes, which are salted and exported to China, the dried fish themselves being sent into the interior of the island. The fish is called 'Trubu' by the Malays, is about eighteen inches long, and it is said that between fourteen and fifteen millions are caught annually.

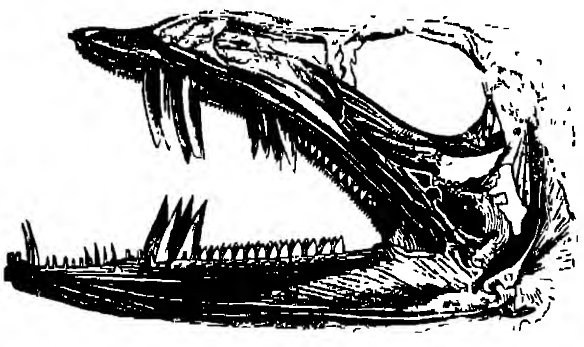
"13. *C. scombrina.* The 'oil sardine' of the eastern coast of the Indian Peninsula."[1]

These quotations will show the value and importance as well as the interest of the systematic and descriptive part of this volume, not a page of which is without some



Toxotes jaculator

lines of most instructive reading, in many cases sufficiently so as to tempt one to turn "Ichthyologist" on the spot. We strongly recommend the reader to turn at once to the pages on the Salmonidæ. This portion too is illustrated with many excellent figures, two of which, through the courtesy of the publishers, we are permitted to reproduce—the first is of a fish belonging to the genus Toxotes. Two species of this genus are known from the East Indies, one of which (*T. jaculator*) is the more common, and it ranges to the north coast of Australia. It has received its name from its habit of squirting a drop of water at an insect which it perceives close to the surface in order to



Skull of *Plagyodus ferox.*

make it fall into it. The Malays, who call it "Ikan sumpit," keep it in a bowl in order to witness this singular habit, which it continues even in captivity.

The second woodcut represents the bones of the head of one of the largest and most formidable of the deep-sea fishes. Of the genus Plagyodus but one species is known (*P. ferox*). It has been found off Madeira and in the sea off Tasmania. Other species have been noticed from Cuba and from the North Pacific, but it is doubtful if they differ specifically from *P. ferox.* The fish grows to a length of six feet, and from the stomach of one specimen have been taken several eight-armed cuttle-fish, Crustacea, Ascidians, a young brama, twelve young boar fishes, a horse-mackerel, and one young of its own species. The stomach is coecal, the commencement of the intestine has extremely thick walls, its inner surface being cellular, like the lung of a reptile, it has no pyloric appendage. All the bones are extremely thin, light, and flexible, containing very little earthy matter. Very singular is the development of a system of abdominal ribs symmetrically arranged on both sides and extending the whole length of the abdomen. Perfect specimens are rarely obtained on account of the want of coherence of the muscular and osseous parts, caused by the diminution of pressure when the fish reaches the surface of the water. The exact depth at which *Plagyodus ferox* lives is not known, probably it never rises above a depth of 300 fathoms, but woe betide any rash intruder that dares to descend into the realms of its abyss.

The volume closes with some directions for collecting and preserving fishes—when practicable fishes when dead should be set to swim in spirit. But we must not quote any more, so leave the curious reader to find out the details of how, having caught his fish, he can cook it so as to make it of value for some national museum.

[1] In this quotation the fin formulæ and references to works on the Herring, &c., are omitted.

SULPHURIC ACID AND ALKALI

A Theoretical and Practical Treatise on the Manufacture of Sulphuric Acid and Alkali, with the Collateral Branches. By George Lunge, Ph.D., F.R.S.E., Professor of Technical Chemistry at the Federal Polytechnic School, Zurich (formerly manager of the Tyne Alkali Works, South Shields). Vol. III. (J. Van Voorst, 1880.)

THE publication of the third and concluding volume of Prof. Lunge's excellent work follows wonderfully soon on that of the first and second. This volume, which fully equals the other two in accuracy of description and clearness of style, is devoted to the subsidiary processes lying alongside of the main channel of Leblanc's great discovery. We first find a chapter on the ammoniacal soda process now rising, through Solvay's exertions, into well-merited and formidable competition with its older rival. The ash made by this theoretically beautifully simple and practically most original process is very pure, containing from 98 to 99 per cent. of Na_2CO_3, and free of course from the impurities common to Leblanc's ash of caustic soda and sulphide of sodium.

But this Solvay's ash is less dense than that made by the old plan, and both German and English manufacturers are now making a Leblanc ash of 98 per cent. free from sulphur and of a dense quality. The struggle, says Lunge, is not now one of purity, but merely of price, and so far Leblanc soda is holding its own. Here however the beneficial action of competition is seen: if Messrs. Brunner, Mond, and Co., of Northwich and Sandbach, were not turning out from 35 to 40 tons of Solvay ash *per diem*, I cannot help thinking that the Leblanc soda-makers might have felt inclined to rest content with their previous performances. There is of course no chance of this new process turning out the old-fashioned plan until the chlorine of the common salt can by this new method

be made available as a marketable article. At present it runs away as calcium chloride, but if Weldon's process for regenerating the chlorine were to prove as successful as his well-known plan (of world-wide application) for obtaining it from the ordinary chlorine-still liquor has proved (and this so far has not come to pass), it is pretty clear that all the old alkali works would have to be closed. Next come the chapters on Bleaching Powder and Chlorate of Potash Here we find thirty-four pages of a practical treatise devoted to the theoretical consideration of the composition of bleaching powder, and even graphical formulæ may be detected on some of these pages, to say nothing of chemical equations of some complexity, involving the discussion of one of the most intricate of chemical problems This is a pretty dish to set before our "typical practical man," who only knows the substance he makes under the names of "B P" or "Chemic," and would be puzzled to say of what it consisted. It is however a species of nourishment which it will do him good inwardly to digest, for if he turns away from it in disgust and dismay, so much the worse for him and his manufacture. "The rule of thumb," as Mr Mundella truly said at Leeds the other day, "is now over, we stand at its grave." Our manufacturers must all be thoroughly trained in the scientific principles which underlie their trades. Noble and great things have been done by Englishmen in the perfection and development of chemical industry, and still greater things remain for them to do, but whilst taking only proper credit for what England has done and is doing, let us not forget that the general scientific education of our manufacturers and managers is far below that of their Continental competitors It is no doubt quite true that no German alkali work could exist were it not for their import duty on English soda, for even with all their care and scientific knowledge, the Germans are unable to compete on equal terms with us, thanks rather to the circumstances of our environment than to any special merits of our own

But this artificial and economically unsound condition of Continental manufacture ought rather to urge us so to complete our system that we not only shall have the advantages which geographical position and geological good fortune places at our disposal, but also that thorough scientific training and the knowledge of what is being done elsewhere, without which all natural advantages become comparatively valueless In this way and in this way only can we, as it seems to me, fight against the incubus of protective tariffs On this necessity for our typical "practical man" to re-consider his position and to arm himself for the technical war with every appliance which science places at his disposal, Dr Lunge speaks so forcibly and so well in the preface to his third volume that I take the liberty of giving his remarks *in extenso*.

I may however express my own doubts whether the British alkali-maker has, as Dr Lunge maintains, in reality been distanced by any foreign manufacturer of alkali or sulphuric acid, except so far as regards the import of British goods into countries where inland production is artificially stimulated by protection. As regards other chemical industries, especially those such as the manufacture of colours, in which great delicacy and care in manipulation and an intimate knowledge of the highest developments of organic chemistry are essential, one must in sorrow confess that Dr. Lunge is perfectly right when he says that the English trade is rapidly passing into the hands of French and German houses.

"Other books aim at nothing but giving an accurate description of the present style of making sulphuric acid and alkali in England; and they leave the chemistry of the subject almost totally aside My treatise differs from this in several respects. First it gives a detailed chemical description of the raw materials, intermediate and final products, of the modes of testing, and so forth, supplemented by numerous tables of solubilities, densities, &c, and it also enters very fully into the theory of all the processes concerned, accurately citing all papers on the subject, so that the reader can go to these for further elucidation I am quite aware that a treatment of this kind will appear lengthy and superfluous to some readers who look into this book merely for 'practical' hints. In this respect they will not, I trust, be disappointed either, but I make bold to say that they would do very well not to despise the scientific part, the purely chemical detail, of this work

"After all, our subject belongs to the domain of *chemistry*, and the times are far behind us when, in the manufacture of chemical products, the practical man with his rule of thumb could look down upon the chemist in the laboratory—who in the former's idea was at best only good for testing the materials, but whose interference with the works would invariably cause mischief That this was true to some extent, and still is so, where the chemist attempts to transfer his ideas into practice in a crude state without sufficient practical experience, nobody can possibly deny. But does the 'practical man' on his part make no mistakes?

"Have not untold sums been wasted in futile 'inventions' and 'improvements' merely because 'practical' inventors lacked a scientific knowledge of their subject? Probably very much larger sums have been lost in this way than by the deficiency in practical experience of 'theoretical' inventors, for the simple reason that the latter class of inventors generally have not so much means at command as the former It is a mere truism that theory and practice should always go hand in hand, but it must nevertheless be inculcated over and over again, as would appear from the fact that several costly books on perhaps the most important branch of chemical industry have just been published with next to no chemistry in them And to what consequences does this neglect of a scientific treatment of practical subjects lead? The author may be pardoned for illustrating this from his personal experience. A little more than sixteen years ago he left his native country for Great Britain, and he might justly hope to learn a great deal and find much more scope for himself in that country which he is proud to have made his second home. More particularly the manufacture of sulphuric acid, soda-ash, and bleaching-powder was at that time quite insignificant in Germany, and not very considerable in France as compared with Great Britain, nor could the technical appliances, the yields, or even the purity of the products in the two former countries vie with those of the latter. How different matters are now is a matter of notoriety The manufacture of chemicals has made enormous strides forward, both in quantity and quality, in France, and even more so in Germany. Many of the chemicals of these countries outstrip those of English works in purity; and their plant and their processes are frequently superior to those used in the majority of English works. Everybody knows how this has come about. The foreign chemists and manufacturers have looked all round, not merely in their own countries, but wherever they could find improved methods and apparatus, and upon the practical knowledge thus gained

they have brought to bear the scientific training they had received at their universities and polytechnic schools Thus they have already, in many fields formerly remunerative to British manufacturers, distanced the latter, immensely aided though these be by their long occupation of the ground and by permanent natural advantages, such as cheapness of coal and of freight, superior command of capital, &c., and this is likely to go on to an increasing extent if many British chemical manufacturers decline to profit from a scientific study of their respective branches This is all the less excusable, as England from of old has been a stronghold of scientific chemistry, and can hold its own against the whole world in that respect"

To these words I will only add that one of the best possible signs of advancement in the study of science so necessary for the permanent well-being of our manufactures would be to find well-thumbed copies of Dr Lunge's three volumes not only on the alkali-maker's shelves, but in the house of every manager, and on the table of every free library in the manufacturing districts.

H E. ROSCOE

OUR BOOK SHELF

Aide-Mémoire du Voyageur Par D Kaltbrunner (Zurich Wurster et Cie, 1881)

THIS is a sort of supplement to the "Manuel du Voyageur" by the same author, noticed in these pages at the time of its appearance The present volume may be described as a collection of constants in all departments of science likely to be of service to the scientific traveller, and indeed to students of many kinds It contains a series of sections in geography (mathematical, physical, and political), geology, biology, and anthropology To each section is prefixed a list of works to be consulted on the particular subject, numerous plates and maps, an index, and a table of authors whose works are cited. The whole work seems to us well put together, the information really useful, and, so far as we have tested, trustworthy, though the lists of works are not always so complete as they might be, this can be easily amended in subsequent editions To all interested in geography in its widest sense, the work must prove of real service

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts No notice is taken of anonymous communications*

The Editor urgently requests correspondents to keep their letters as short as possible The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Geological Climates

I SHOULD not say more on this subject, but that the last paragraph of Mr Starkie Gardner's letter seems to imply that I have adopted some of his views without acknowledgment. Now I certainly read his article in NATURE of December 12, 1878, with much interest and profit, but, as regards the special question of the cause of the mild climates of Eocene and Miocene times, I entirely disagreed with his views, as is sufficiently shown by my recent letter in NATURE I quite admit that the closing up of the North Atlantic between Europe and North America *might* have considerably raised the temperature of Britain, but it would just as certainly have rendered the Arctic regions even colder than they are now, by shutting out the Gulf Stream, whereas all the evidence points to *continuous* mild Arctic climates through Cretaceous, Eocene, and Miocene times Again, though I admit that there has probably, on more than one occasion during the Tertiary period, been a land connection between North-West Europe and North-East America, yet the peculiar distribution of the Tertiary mammalia of Europe and North America indicates that such connection was exceptional, and only endured for very short periods, the rule being a separation like that which now exists I could therefore only have quoted Mr Gardner's view to disagree with it, and I did not think it advisable to encumber the exposition of my own theory with more references of this kind than were absolutely necessary. I may add, that the extension of the Miocene Arctic flora to Grinnell Land since Mr Gardner's article appeared, renders his views still more untenable. Of course I here refer to my chapter on "Mild Arctic Climates" in "Island Life" In my letter to NATURE I confined myself strictly to the point raised by Prof Haughton, which I did not consider had been adequately met by Mr Gardner's hypothesis.

ALFRED R. WALLACE

Is your correspondent, Mr Ingram of Belvoir Castle, quite certain that he has not confused the *Araucaria Cunninghami* of Queensland with *Cunninghamia lanceolata* of China? The names are misleading

H KING

Chithurst, Petersfield

Temperature of the Breath

FROM time to time during the past few months letters on "the temperature of the breath" have appeared in NATURE, and some conjectures have been advanced regarding the cause of the high temperatures produced by breathing on thermometers enveloped in silk or other materials

One of the correspondents supposes that the high temperature thus produced indicates a cooling action of the breath The refrigerating agency of respiration by the heating of respired air and by evaporation from the lungs is sufficiently well known, and has been calculated by Helmholtz, but it is scarcely logical to ascribe to the breath a temperature so obviously produced by the intervention of another agent, and this hypothesis would involve the rejection of all observations hitherto made by physiologists on the temperature of the breath and of the blood

A few lines which appeared in NATURE of October 7 indicated what appeared to me to be the simple and philosophical explanation (*i e* hygroscopic condensation) of the phenomenon under discussion The higher temperatures produced in dry than in wet weather, and by some materials than by others, distinctly point to the hygroscopic state and nature of the material as the modifying influences

The question is entirely physical, and not physiological Wrapping the thermometer is a new factor in taking the temperature of the breath, and is, *primâ facie*, the cause of the high temperature Some further experiments which I have just completed place the matter beyond all doubt Not to occupy your space with unnecessary details, I give only an outline of them —

1 A current of air directed upon the bulb of a naked thermometer caused no appreciable rise neither did the mercury rise when the bulb was enveloped in silk, but when it was enveloped in *dried* silk it rose several degrees (The silk was dried by heat, and allowed to cool in a stoppered bottle)

2 Three thermometers—(1) bulb naked, (2) bulb wrapped in silk, (3) bulb wrapped in *dried* silk—placed in a current of *hot damp* air for some minutes, marked respectively 116°, 120°, and 123° F

3 Two thermometers, one naked, the other wrapped in silk, were placed in a flask, with their stems passed through the cork The flask was then immersed in hot water (about 150° F) The naked thermometer rose rapidly, the covered one very slowly After twenty minutes the temperature of the water was 120°, and the naked thermometer marked 112°, while the covered one registered only 108°.

4 Two thermometers, one naked, the second wrapped in dried silk, were fixed in a flask as for last experiment, but a little water was placed in the flask, which was then plunged into hot water as before The naked thermometer rose rapidly at first, but it was soon outstripped by the covered one The following was the result after some minutes —Water, 128°, naked thermometer, 118°, covered thermometer, 136

5. Two thermometers, one naked, the second enveloped in dried silk, were passed through a cover fitting a glass vessel which was carefully dried and heated, and the cover was cemented on to prevent the passage of moisture from the air. After an hour the naked thermometer had cooled to 81° (temperature of air), and the covered one to 83° They were then changed to a similar vessel containing a little water, the

covered thermometer rose rapidly till it nearly touched 94°, while the naked one remained stationary.

The conclusions to which these experiments point are too obvious to require demonstration. C. J. McNally

Madras, December 9, 1880

Selenium

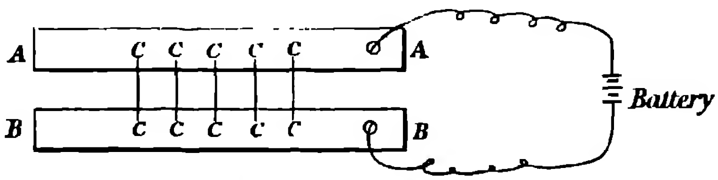
The use of selenium in the photophone has suggested to me the possibility of using it in two ways, which I shall now describe, thinking you may perhaps consider them of sufficient general interest to publish in Nature.

Firstly, it seems probable that selenium might be used to obtain the automatic registration in a chronograph of such phenomena as star transits. It possesses the property of being drawn into fine wire at a low temperature, but whether it can be drawn fine enough to represent transit wires in a telescope I do dot know.

The arrangement would be as shown in the diagram, where A A B B are parallel metal plates crossing the field of the telescope, and insulated from each other except by the selenium wires C C C C in one direction, and by a wire circuit passing through a battery, and a relay, R, in the other. The relay should be so adjusted that the increased force of the current passing through the circuit caused by the light of a star falling on each wire C C in succession, shall cause its armature to act, and pass on a signal to the chronograph.

The delicacy of the adjustment required for this purpose might be a greater difficulty than I am aware of; but it should be borne in mind that the length of selenium in the circuit may be very small, as the plates A A B B need not be farther apart than sufficient to insure the star's falling between them without excessive accuracy of setting, say one-twentieth to one-tenth of an inch in a telescope of moderate size. If necessary, it would be simple enough to give each wire C C its own distinct circuit. Should the brittleness of the wires prove a difficulty, they may be supported between the plates A A B B in any convenient way which does not interfere with the insulation of these plates.

The second purpose would perhaps be of more practical use than the above, viz. to secure an automatic daily time-signal.



Let a thin plate of selenium be placed between, and in firm contact with, two parallel plates of metal, which are connected with each other by a wire passing through a battery and a relay as above, so that the selenium alone interrupts the circuit. Then if this plate be placed with its length in the meridian, and a lens adjusted above it, so as to throw the image of a star, or the sun, as it crosses the meridian exactly on the selenium, a signal will be obtained from the relay as before, which in this case may be the stroke of a bell or any other convenient sound.

An ordinary lens would require constant changes of adjustment if used for the sun, moon, or any body of varying declination, but if the lens were the central slice cut out of a sphere by two small circles parallel to each other and equidistant from the centre, placed with its flat sides parallel to the meridian, while the selenium was placed in a curve concentric with that of the lens, at the proper distance from its surface, and of sufficient length—of course being accurately in the meridian—then any heavenly body of whatever declination—between certain wide limits—would throw its image on the selenium and afford a signal, if of sufficient brightness. The arrangement of a warning-signal would be easy.

If this method proved practicable the objection would remain of having to apply a correction to obtain mean time, which would probably prevent its being used for public purposes, such as dropping time-balls or firing time guns. It seems to me however that it might nevertheless prove very useful to many private individuals who require an accurate knowledge of time.

Poona, December 3, 1880 W. M. C.

Experiments with Vacuum Tubes

At a meeting of the Philosophical Society of Glasgow on December 22, 1880, I gave a very brief preliminary account of some experiments that I have been making, along with Sir William Thomson, with vacuum tubes. We have sealed up English and German glass tubes with very high vacuums, but without any electrodes, and have obtained very remarkable luminous effects both with the Ruhmkorf coil and also working by means of electrostatic induction. Using an ordinary frictional electric machine, and applying one end of a long vacuum tube to the prime conductor, while the other end of the tube is held in the hand, the tube becomes charged as a double Leyden jar in the following way:—one end of the tube, next to the prime conductor,—outside positive, inside negative, the other end—inside positive, outside negative. This can be shown by the gold leaf electroscope. The charges seem to be very high and the glass is very frequently perforated. Indeed it is difficult to work with the electric machine in tolerably good order without perforating the glass. While this double Leyden jar is slowly discharged, by removing, part by part, the charges from the outside of the tube, beautiful luminous effects are observed very different from those seen in the ordinary vacuum tubes. We have also obtained curious effects by heating the middle region of the tube so highly that it becomes a semi-conductor. J. T. Bottomley

Physical Laboratory, University, Glasgow, December 29

Modern Use of Ancient Stone Implements

Perhaps the following statement will interest some of your readers:—In an old volume, "Thomae Bartolini Acta hafniensia," Ann. 1674, 1675, 1676, I find a paragraph signed by Olaus Borrichius, which clearly indicates that in the seventeenth century ancient stone implements, and probably many of them, were converted into flints for the use of the contemporaneous musquetry. The text runs thus:—"Silices Anholdini triangulares. Insula haec [Anholt in the Kattegat] porrigitur in sinu codano, minuta illa quidem et naufragiis multorum infamis, uno hic laudanda quod si quis arenas littoris ejusdem scrutetur, infinitos reperiat silices nigros, albos, varios, in sabulo hinc inde sepultos, ad sex transversos digitos in longitudinem protensos, latos digitum unum, omnes triquetros ac si manu artificis fuissent acuminati, et lateribus plerumque in illam aciem excitatis, ut Iosuae servire potuerint cultris saxeis filiorum Israel circumcisionem imperanti. Nunc ferreo hic seculo in alios vocantur usus: malleo enim in frusta convenientia divisi sclopetorum rotulis ignem prompte ministrant et fomitis incendiarii loco fulmineis bellatorum tubis ancillantur." D. Budde

Rome, December 26, 1880

Pile Dwellings

If the connection between pile dwellings in the Swiss lakes, the Swiss châlet, and the Malayan modern pile dwellings is demonstrated, a decided advance has been or will be made in prehistoric anthropology.

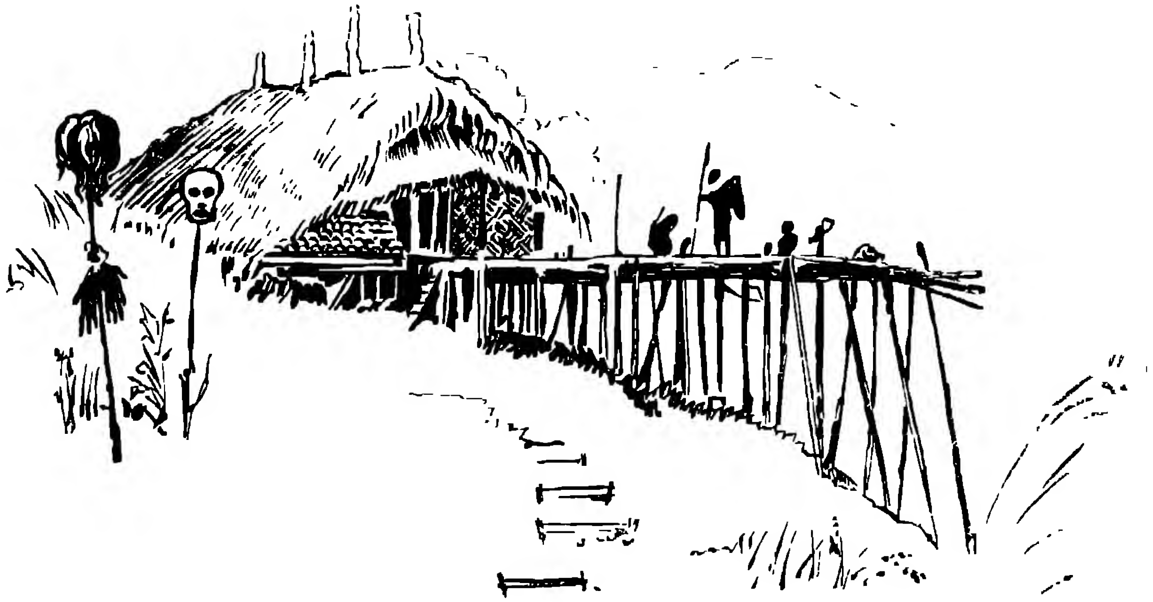
Pile dwellings are a very distinct characteristic of all the Hill races north east of Bengal, except those on the Kasia Hill ranges, and so far as I can see is a conspicuous distinction between the Aryan and non-Aryan races here.

The persistence with which this custom is retained among tribes who have migrated to new sites, where the need is not obvious, seems to offer a safe means of tracing to some extent racial descent or relationships.

The "Miris" of Asam offer a case where part of the tribe is still in its hills, while the rest are more or less scattered along the Brahmaputra in the level land of Asam, and build houses alike. The Ahoms, a Shan race who invaded and settled in Asam in A.D. 1228, built pile dwellings, and the "Deodhaings," who are lineally descended from them, do so now. The Butias

Daflas, Akas, Abors, Mishmis, Singphus, and Nagas (all) build pile-dwellings, as do the Kamtis

Several peculiarities are noteworthy, *i.e.* that the custom is confined to *hill races*, and not seen in plain races, that the invariable explanation offered to inquiry is that on the hill tops and spurs, where *alone* the villages are built, there is very little



level land; also that this form of house is a necessity among races that keep pigs and goats, which to any casual visitor is at once obvious

As it is possible that this question may afford unexpected results when examined, I inclose sketch of a Naga "Morang," or skull house, which with its platform is the same as those they live in Different tribes have variations of the pattern, and most have the platform balcony in some shape or other, and the posts go through the roof in some Nagas houses alone

Asam S. E. PEAL

Landslips.—The Cheshire Subsidences

UNDER the guidance of Mr. Thos Higgin, F L S., and your correspondent Mr Ward, I have just been examining the subsidences that have been lately taking place in the neighbourhood of Northwich To understand how they occur, it is necessary to know that there are two beds of rock salt in the Triassic marl. The upper bed, 25 yards thick, is from 40 to 60 yards below the surface, the lower, 35 yards thick, is separated from the upper by about 10 yards of hard marl The greater bulk of the salt is obtained in the form of brine pumped up from the upper bed. The lower bed is to a smaller extent worked as a salt-mine. From these operations two classes of subsidences result; the one general and gradual, due to the removal in solution of the rock salt of the upper bed by percolation of water and pumping, by which the surface of the ground sinks in undulations, the other, sudden fallings in of the ground into the mines, forming crater-like pits. It is to these I wish to call attention I was fortunate enough to see one before it had become, as they all do, partially filled with water I should judge it to be about 70 feet deep, 150 feet diameter at the top, and 20 or 30 feet at the bottom, where a little water was lodging The problem to account for is how such an inverted cone of marl capped with boulder-clay and drift-sand could apparently have disappeared through so small a hole? The explanation appears to be this By percolation of water the roof of the mine begins locally to give way and fall into the mine, gradually working its way to the surface, where it first appears in the form of a hole about the size of a well. The vacuity will no doubt take a conical form, the base being at the roof of the mine, once the hole is formed, the surface ground begins to slip and fall in around, gradually enlarging the orifice, the material disappearing into the mine below. This continues until the bottom is filled up and the sides of the "crater" attain the angle of repose. The whole thing will occur in a night. The subsidences certainly present a very remarkable appearance from the regularity of their circular or elliptical form and funnel crater-like shape. It is evident such subsidences could not happen except under special conditions, such as are provided by salt-mining and pumping in these Keuper marls. T MELLARD READE

Park Corner, Blundellsands, Liverpool, December 22, 1880

Animal Reasoning

I SEND an account of a singular act of animal intelligence which may not be uninteresting to the readers of NATURE. A lady, a friend of mine, was at one time matron of a hospital for poor women and children which was maintained by subscription. One of the inmates was a blind girl who was there not as a patient, but temporally till a home could be found for her She had learned to feed herself, and at meal times a tray containing her dinner was placed on her knees as she sat in a comfortable chair for her special convenience in feeding herself One day while she was eating, the pet cat of the establishment placed herself before the girl and looked long and earnestly at her, so earnestly that the matron, fearing the animal meditated some mischief to the girl, took her out of the room Again the next next day, at the same hour, the cat entered the room, but this time walked quietly to the girl's side, reared herself on her hind legs, and noiselessly, stealthily reached out her paw to the plate, selected and seized a morsel that pleased her, and, silently as she came, departed to enjoy her stolen meal The girl never noticed her loss, and when told of it by her companions laughed very heartily

It is evident that the cat from observation had entirely satisfied herself that the girl could not see, and by a process of reasoning decided she could steal a good dinner by this practical use of her knowledge. K P

Cambridge, Massachusetts

Ozone

THE letter of J. P. on this subject hardly gives enough data to enable one to found an opinion upon, but is it not possible the paper is coloured by ozone from the air? It is well known that a flame is the most potent method of collecting atmospheric electricity, and a properly-insulated spirit flame ignited in dry air seldom fails to show some traces. I would suggest the experiment being repeated on the exposed plate of a gold leaf electrometer, the surrounding conditions of place, air, &c, being noted - also under a bell glass, where such conditions would be varied. Ozone is very strong just now, my paper this morning reaching 10, the limit of Negretti and Zambra's scale. J. RAND CAPRON

Guildown, December 28, 1880

THE INDO-CHINESE AND OCEANIC RACES—TYPES AND AFFINITIES[1]

II.

A BELIEF in sorcery is very general, especially amongst the Melanesians, and some of the practices associated with it often resemble those prevalent amongst the Australians and African Negroes, and even in mediæval times in Europe In Tanna, New Hebrides group, Dr G Turner tells us that the real gods "may be said to be the disease-makers It is surprising how these men are dreaded, and how firm the belief is that they have in their hands the power of life and death There are rain-makers and thunder-makers, and fly- and mosquito-makers, and a host of other 'sacred men', but the disease-makers are the most dreaded It is believed that these men can create disease and death by burning what is called *nahak* Nahak means rubbish, but principally refuse of food Everything of the kind they burn or throw into the sea lest the disease-makers should get hold of it These fellows are always about, and consider it their special business to pick up and burn, with certain formalities, anything in the nahak line that comes in their way. If a disease maker sees the skin of a banana, for instance, he picks it up, wraps it in a leaf, and wears it all day hanging round his neck. The people stare as they see him go along, and say to each other, 'He has got something, he will do for somebody by and by at night' In the evening he scrapes the bark off a tree, mixes it with the banana skin, rolls up tightly in a leaf in the form of a cigar, and then puts the one end close enough to the fire to cause it to singe, and smoulder and burn away gradually Presently he hears a shell blowing 'There,' he says to his friends, 'there is the man whose rubbish I am now burning, he is ill Let us stop burning and see what they bring in the morning'

"When a person is taken ill he believes it is occasioned by some one burning his rubbish Instead of thinking about medicine he calls some one to blow a shell, which, when perforated and blown, can be heard two or three miles off The meaning of this is to implore the person who is supposed to be burning the sick man's rubbish and causing all the pain to stop burning, and it is a promise as well that a present will be sent in the morning The greater the pain, the more they blow the shell, and when the pain abates they cease, supposing that the disease-maker has been kind enough to stop burning Then the friends of the sick man arrange about a present to be taken in the morning Pigs, mats, knives, hatchets, beads, whales' teeth, &c, are the sort of thing taken. Some of the disease-making craft are always ready to receive the presents and to assure the party that they will do their best to prevent the rubbish from being again burnt If the poor man has another attack at night he thinks nahak is again burning. The shell is again blown, and so they go on, and if he dies his friends lay it all down to the disease-makers, as not being pleased with the presents taken and as having burned the rubbish to the end. The idea is that whenever it is all burned the person dies" ("Nineteen Years in Polynesia") Substitute for the nahak a waxen image of the absent victim, and you have in this account a perfect parallel to the belief in the power of witchcraft to injure at a distance universal at all times in Europe:—

> "Devovet absentes, simulacraque cerea fingit,
> Et miserum tenues in jecur urget acus."
>
> (Ovid, *Epist* 6)

But this merely shows how little reliance can be placed on similarity of manners and customs in tracing the affinities of races The mind of man having sprung, as seems most probable, from one original centre, is everywhere very much the same in the infantile or undeveloped stage Hence, like practices under like conditions may very well arise independently in diverse places without implying any ethnical relationship or even any necessary social contact The most extravagant theorist would scarcely venture to suggest any direct relationship of any sort between the Papûans, for instance, and the Basques, yet amongst the young girls of both races the extraordinary taste for making pets of little pigs prevails At least the practice is spoken of by recent explorers as common in New Guinea, while Mdme. d'Aulnoy ("Relation du Voyage d'Espagne," Paris, 1691) was greatly surprised to find the young Basque ladies of Bayonne indulging in the same habit when she visited the place in 1679 "Some of those who came to see me had a little sucking-pig tucked under their arms, just as we carry our little lap-dogs. Several had ribbons of different colours tied round their necks as collars But when the ladies joined in the dance they were obliged to let the horrid beasts loose in the room, where they made more noise than so many imps." The "couvade" is another remarkable custom attributed both to the Basques and to the Buru Islanders, Eastern Archipelago, in common with many other peoples ancient and modern in the Old and New World But M Julien Vinson (*République Française*, January 19, 1877) has shown that, at least as far as regards the Basques, there is little or no ground for the statement We all know what astonishing conclusions as to ethnical affinities certain ethnologists have drawn from the assumed common prevalence of this eccentric fashion amongst the most widely-dispersed nations Yet even if it did exist amongst them such conclusions would be otherwise inadmissible

It may be mentioned that the missionaries have been for some years at work amongst the Mafôr people and their kinsmen of Dorey, into whose language they have translated several tracts and portions of Scripture Here is a specimen from Genesis i 1 ('In the beginning," &c). "Beponeia kaku man-eren allah ibejadi nanggi ma dûnya Dûnya ibeurba ma ibro beri, ma ifnuiep kôn ro bo i, ma rûi manseren allah bieda inob ro bo wâreya." The Malay, or rather Arabic words, *allah*, God, *dûnya*, earth, *rûr* for *rûh*, spirit, are of course borrowed by the translator, but the structure of the language is entirely different, being highly agglutinating and employing both pre- and post-fixes, like other Papûan dialects. In other respects the Papûan and Melanesian tongues differ so profoundly from each other that it is impossible to group them in one linguistic family As a rule they possess absolutely nothing in common beyond a certain uniformity of structure and such verbal resemblance as is due to Malay and Sawaiori influences These influences are very wide-spread, as shown especially in the numerals, which the dark races have almost everywhere borrowed from their brown and olive neighbours But they often still retain the old quint system at one time common to Indo-China and Malaysia, but in the Oceanic area now mostly replaced by the decimal Thus in the Duke of York Islands, between New Britain and New Ireland, the five first numerals only are taken from the Sawaiori or Eastern Polynesians, the numbers beyond five being expressed by addition, as in Cambojan and several Malayan and Western Papûan dialects Hence for the Samoan *e ono* = six, *e sefulu* = ten, we have *limadi ma ra* = 5 + 1, *limadi ma limadi* = 5 + 5, where *limadi* is from the Samoan or Eastern Polynesian *lima* = 5 By an analogous process the numerous Sawaiori words that have found their way especially into the Eastern Papûan idioms are always compelled to conform to the agglutinating character of Papûan grammar. Thus the Fijian and Duke of York *tama* = brother, apparently answering to the Samoan *tama* = boy, assume the pronominal postfixes *zu*, *g*, *na*, &c, peculiar to those groups, the Fijian *tamazu* and Duke of York *tamag* being equivalent to the Samoan *o lo'u tama* = my brother or my boy Here we

[1] Continued from p 203

clearly see how entirely the structure of the Papûan differs from that of the Sawaiori tongues, and how constant is the law that languages of different systems may borrow any number of words from each other, while each invariably retains its own grammatical genius Hence, when we hear of mixed Papûan, Malayan, and Sawaiori tongues in these regions the expression is always to be understood as referring to the vocabularies only, never to the grammar or structure of those languages In philology there is no rarer phenomenon than mixed grammatical systems, though perhaps it might be premature to deny the absolute possibility of such mixture

III. THE AUSTRAL RACES *Australians, Tasmanians* (?)

The area occupied by this division of the dark races is limited to the Australian continent and neighbouring island of Tasmania. Here we enter an entirely new ethnical world, for, although the extinct Tasmanians betray certain doubtful affinities to the Melanesians, the Australians stand quite apart. They are usually represented as black, straight-haired, dolichocephalous, and prognathous But this general description can pretend to no scientific accuracy, and in any case it is extremely doubtful whether they can be regarded as all belonging to one original stock. Topinard, who has devoted great attention to the subject, recognises at least two distinct aboriginal types, the fusion of which results in the average Australian as above described, and whose essential peculiarity may be said to consist in the combination of more or less negroid features with straight hair The more primitive race, found mainly on the low-lying coast tracts about King George's Sound, in the north-west and extreme east, is described as of short stature, very black and prognathous, with woolly or at least frizzly hair, the second and finer race, occupying the interior, and especially the north-eastern highlands, are much taller, of lighter colour, with straight or wavy hair, and slight prognathism

But, notwithstanding these discrepancies, Brough Smith well observes that "throughout Australia the natives exhibit a general conformity to one pattern as regards features, colour, and mental character A man from Southern Gippsland [Victoria] would be recognised as an Australian by the inhabitants of Port Essington, and a native of King George's Sound would be surely known if taken to York Peninsula" This common racial instinct or fellow-feeling is perhaps our best justification for treating as an independent ethnical group a people for whom affinities have been sought far and wide, by Huxley with Logan in India, by others in Polynesia, Egypt, Europe, or America. One of the arguments adduced in support of an Egyptian or Indian relationship is based on the assumed resemblance of the throwing-sticks of those peoples with the Australian womguine or boomerang, but Brough Smith ("The Aborigines of Victoria," i p 323), who has gone thoroughly into this question, concludes that "it is safe to deny the affinity of the Dravidian or Egyptian boomerang with that of the Australian native, because the first, under no circumstances whatever, could be made to behave as the womguine does The flat leaf-like weapon of the Australian differs essentially from the Egyptian crooked stick" Much reliance is also placed on a certain resemblance between the Dravidian and Australian systems of kinship. But when we find that L. H. Morgan discovered a somewhat similar system prevailing throughout the North American tribes, and that the Rev Lorimer Fison was able to extend its domain to the South Sea Islanders, we begin to attach less importance to a character of this sort *Quod nimis probat nihil probat* was a sound maxim amongst the schoolmen

The Australian languages, which, with great differences, present a remarkable uniformity of structure and phonetics throughout the continent, have also been compared with the Semitic, Aryan, and other systems, but with no results, except where the unscientific method has been adopted Thus *murry*, great, is compared with the Keltic *mor*, or the English *more*, *cobbera*, head, with the Spanish *cobra*, quite a modern formation, *gibber*, rock, with the first syllable of *Gibraltar*, of which the true Arabic form is *Jebel*, *hieleman*, shield, with the Anglo-Saxon *helian* or *heligan*, to cover, or with the English *helmet*, which the ingenious etymologists are careful to tell us is "a little shield for the head", *cabohn*, good, with the French *bon*, *tiora*, land, with the Latin *terra*, *kirafi*, wizard, with the Greek χειρουργός, *ruwi*, country, with the Latin *rus*, *takkin*, eating, with the English *take in* (why not *tuck in* ?), *marli*, limestone, with *mortar*, beyond which it would be difficult to carry etymological eccentricity. Many of these languages are highly agglutinating, some even verging on true inflection, but scarcely any have distinct names for the numerals beyond 1 and 2, after which $3 = 2 + 1$, $4 = 2 + 2$, and so on

This common feature alone should be sufficient to reject any Semitic, Aryan, or Dravidian affinities, for if the Australians came of any of those stocks, it is not to be believed that all the tribes would have agreed to forget their inherited arithmetical system, and stop short precisely at the inconveniently low numeral 2 At the same time it is conceivable that at an extremely remote age, while Australia still formed part of the Asiatic mainland, tribes resembling the Korumbas, Maravars, Todas, and other low-caste peoples of the Deccan, may have spread southwards and here amalgamated with others of a Papûan type from Melanesia The result of such an intermingling might be a race not unlike the present average Australian—dark, prognathous, more or less dolichocephalous and with wavy or shaggy hair intermediate between the frizzly and straight But these migrations cannot have taken place since the subsidence of the land, because none of the races in question are navigators, although some of the New Guinea tribes have recently learnt the art from the Malays On the other hand the remoteness of the period to which such movements must be referred is no objection, for Australia has been peopled for many ages, as is evident from the vast kitchen-middens found on the coast, and some of which have already been used as manure by the white settlers

The extremely low estimate of the Australian intellect formed by Mr Wake and other ethnologists seems at least somewhat premature, and no one can turn over the pages of Brough Smith's great work on the Aborigines of Victoria without coming to the conclusion that the race has been much vilified and unduly depreciated by careless or superficial observers Many instances are given of their skill even in drawing, a capacity for which was wholly denied them They often show great quickness in adapting themselves to the ways of the white man, and the children constantly show themselves "quite as capable of receiving and profiting by instruction as the children of untaught parents among the white race" (*op cit* ii p 256). It was recently stated that the native school at Coranderrk, on the Yarra, had gained relatively more passes than any other school in Victoria.

At the same time most of the tribes are addicted to extremely revolting practices, those by which the "coming of age" is celebrated being especially barbarous and disgusting Some also, under unfavourable conditions, have either sunk to, or never risen from, the most debased condition compatible with existence Mr. Taplin was acquainted with a Narrinyeri family, "residing on Lake Alexandrina, the members of which were as nearly brutes as they could be. They subsisted on roots and native fruits, and such fish and game as came into their hands by means of the simplest contrivances, the thrown waddy, or the simple noose, and they were regarded by their own people as very low They would not even make a shelter, but cowered under bushes and in holes; and yet it could not but be evident how far they were

above the brute. The man could make twine, the woman a rush basket" (*op. cit.*, p. 10)

Cannibalism has also been prevalent, assuming amongst some tribes a very revolting form.

Unfortunately not many of the Aborigines are left to benefit by the enlightened and humane system of treatment tardily introduced by the local administrations There are probably not 30,000 left in all Australia; even those of Victoria, who are best cared for, are dying out except in a few favoured stations, and "Lalla Rookh," the last of the pure blood Tasmanian women, died in June, 1876 The Tasmanians differed in many important respects from the Australians They were of darker colour and considerably less dolichocephalous, with decidedly frizzly hair, this latter feature bringing them into close connection with the Melanesians. In point of culture they stood almost on the lowest level, possessing no fixed abodes, wearing no clothes, never cultivating the land, unacquainted with the rudest arts, possessing neither domestic animals, pottery, nor the boomerang or bows and arrows of the Australians. They were divided into a great number of tribes, speaking as many as nine quite distinct languages, but so little developed that the sense was largely eked out with the aid of gesture and signs Yet their cranial capacity seems to have been slightly greater than that of their neighbours (index 80 as compared with 78), while they were nearly as orthognathous as Europeans. These contradictions constitute the Tasmanian a type *sui generis*, allied partly to the Australian, partly to the Melanesian and Polynesian, with some special features which may perhaps be due to their long isolation from other races.

B—CAUCASIAN TYPE

IV CONTINENTAL BRANCH. *Khmêr or Cambojan Group*

In Further India, with one exception, all the settled peoples forming recognised nationalities, that is, the Burmese, Thai or Siamese and Annamese, are physically of Mongolian stock, and all speak languages of the monosyllabic or isolating class The same is largely true of the Mishmis, Khasias, Kukis, Nagas, Khyengs, Karens, and other wild tribes in the west and north-west, as well as of the Shans, Mou-tz', and many Miau-tz' tribes in the north Hence the universal assumption that, excluding Malacca, all the inhabitants of the peninsula constitute one ethnical and linguistic group allied to the Chinese in the north and to the Tibeto-Himalayan races of the north-west, and with them forming collectively the great South-Eastern division of the Mongolian family This comfortable theory was first shaken by the revelations of the famous French expedition of 1866-8 up the Me-Khong River, since when the writings of Dr Thorel, Francis Garnier, E Aymonnier, C E. Bouillevaux, Dr Harmand, and other French naturalists have made it abundantly evident that there is in this region an important non-Mongolian element, which must henceforth be taken into account. Yet so slowly does scientific truth make its way against long-established error, that the fact has scarcely yet been recognised in any comprehensive treatise on ethnology or linguistics In a paper prepared for the meeting of the British Association in Sheffield in 1879, and since published in separate form,[1] I endeavoured to determine the true nature of this non-Mongolian element, and to point out its essential importance in connection with the classification of all the Indo-Chinese and Oceanic races It was there shown that the Khmêr or Cambojan nation, the exception above referred to, together with a large number of kindred peoples inhabiting the Lower Mekhong basin and the region between that river and the Coast range running from Cape St James northwards to the Chinese frontier, form a distinct racial and linguistic group, of the same physical type as the Mediterranean or Caucasian races of the west, and closely akin to the brown Oceanic races of Malaysia and the Pacific

The arguments brought forward in support of this view need not here be formally repeated, and it will be sufficient to vindicate the use of the term "Caucasian" as thus extended to the remotest Polynesian islands It has been objected that there are no Aryan languages in the far east, and that the Eastern Polynesians are a brown race, consequently that the word Caucasian cannot here apply. But those who so argue seem scarcely to realise the nature of the problem Caucasian is not a linguistic, but an ethnical expression, hence although the Aryan, Basque, Semitic, and many languages of the Caucasus have no conceivable relationship with each other, we do not hesitate to regard those who speak these languages as of one stock because their physical type is substantially the same. This type we conventionally call Caucasian or Mediterranean, which terms must be held to apply wherever the physical features implied by them are found, irrespective altogether of the language question Why speech and type should not correspond is another problem, which admits of an obvious solution, but which cannot here detain us.

The objection based on colour, though more to the point, is scarcely more forcible The brown Polynesians are not supposed to spring directly from the fair Europeans, but to have gradually spread from Indo-China through Malaysia to their present homes, and it will be presently seen that there are peoples in Indo-China brown enough to suit the Polynesian taste, and fair enough to claim kinship with the western nations. Besides, the question of colour must anthropologically be regarded as altogether of secondary importance There are black Caucasians in Abyssinia, deep brown Caucasians in the Ganges Valley, dusky or swarthy Hamites and Semites, also Caucasians, in North Africa and Arabia, and why may there not be brown Caucasians in Polynesia? Surely the evolutionist, who does not hesitate to accept the development of the *genus homo* from some anthropoid ape, need not scruple about the relationship of the human species because of such a secondary matter as colour Schweinfurth tells us that albinism is common amongst the negroes of the Nile basin, and there is at the present moment a clear case of melanosis in London If these be regarded as morbid symptoms, they are often hereditary, and it has not yet been shown that they may not be cases of atavism, such as the reappearance of the bars on the pigeon's wing, however far removed from the original blue-rock type *Nimium ne crede colori*, wisely said Linnæus, speaking of plants, and the remark is equally applicable to the animal kingdom Observing that the black pigment does not make its appearance on the Negroes of Loango, West Coast of Africa, until after birth, the Berlin anthropologist Falkenstein suggests that it may be due to the action of the solar rays If so, what becomes of colour as a fundamental characteristic at all?

Besides the civilised Khmêrs, forming the bulk of the present kingdom of Camboja and neighbouring Siamese provinces of Ongkar and Battambang, the chief Caucasian peoples of Indo-China are the Chams, Charays, Bolovens, Stiêngs, Suê, Xong, Cedangs, Rhoedehs, Banhars, Samrê, Lemets, and Kûys, the last of whom are looked on by the Cambojans as the primitive Khmêr stock; hence are called by them *Khmêr dom*, or "original Khmêrs" In the paper above referred to the physical characteristics of these tribes are thus summed up mainly from Thorel —"A fine, vigorous race, with symmetrical and well-set frames, stature rather above the middle size, straight profile, oval face, dolichocephalous head, high forehead, retreating very slightly, black hair, often inclining to brown, straight or wavy and elliptical in section,

[1] "On the Relations of the Indo-Chinese and Inter Oceanic Races and Languages" (Trübner, 1880)

beard and whiskers well furnished and always frizzled, or at least wavy, eyes perfectly straight and horizontal, nose not particularly prominent, but nearly always straight and never flattened at the root, cheek-bones scarcely if at all prominent, mouth of medium size and even small size, with moderately thick lips but no trace of prognathism, complexion mainly of a bister or brown colour, but varying from fair and even white to light brown and dark, though never so dark as that of the Aryans of India."

This description, given by a scientific observer, is the very antithesis of the Mongolian, and corresponds in all essentials to the ordinary Caucasian of Western Asia and Europe. Hence it is not surprising to find recent French writers freely applying to these peoples such epithets as "Caucasique," "Indo-Européen," "blanc," and so on. Bouillevaux calls the Chareys "white savages of Caucasian type." Thorel connects the northern tribes with "the Caucasian race, or more correctly with the Indo-European peoples." Dr. Harmand gives us a description of a beautiful Khang woman, dwelling particularly on her "aquiline nose, large eyes, thin lips, round shoulders," and other points of a European character. The Bolovens of Bassac he describes as of lighter complexion and taller than the surrounding Laos (Mongoloid) peoples, with sub-dolichocephalous head,

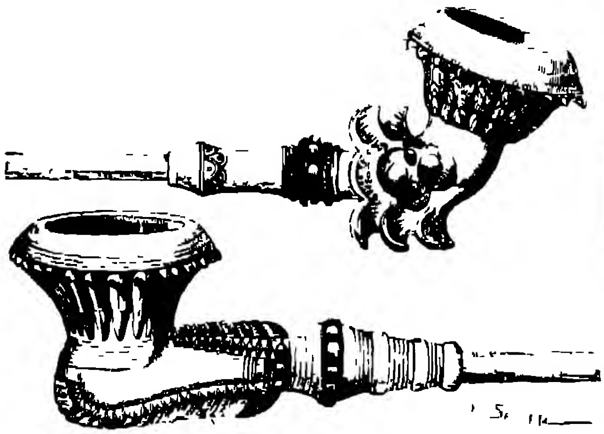


Fig. 11.—Stieng Pipes.

whereas that of the Laos is decidedly brachycephalic. Many Boloven women are remarkably beautiful in the European sense, with large straight eyes, regular features, and ruddy rather than yellow complexion. The colour of these wild tribes is often described as darker than that of their Siamese and Laos neighbours, but Dr. Harmand points out that this is due to the deep-rooted prejudice of the Laos, who habitually speak of them as even "black," though often fairer than the Laos themselves. The essential difference between the two races in this respect is precisely what we should expect, the Thai being more yellow, the Khâs, or Caucasian wild tribes, more red. This red or ruddy tinge was also noticed by Dr. A. Maurice amongst the Banhars, and the Piâks are even said to have wavy black hair with a russet hue, a trait never occurring in any pure branch of the Mongolian family.

These Caucasian tribes seem to be the true Aborigines of Indo-China, where they have been mostly supplanted, or driven to the impenetrable forests and highlands of the south-east by the intruding Mongol races, descending by the valleys of the great rivers from the Tibetan plateau. Still one branch, the Khmêrs, or Cambojans, were powerful and numerous enough to hold their ground in the lower Mekhong Valley, where, under Buddhistic influences, they established a flourishing empire and erected monuments 2000 years ago, whose stupendous ruins rival those of Java and India itself in archæological and artistic interest. Indeed it may be doubted whether there is anything in the whole world

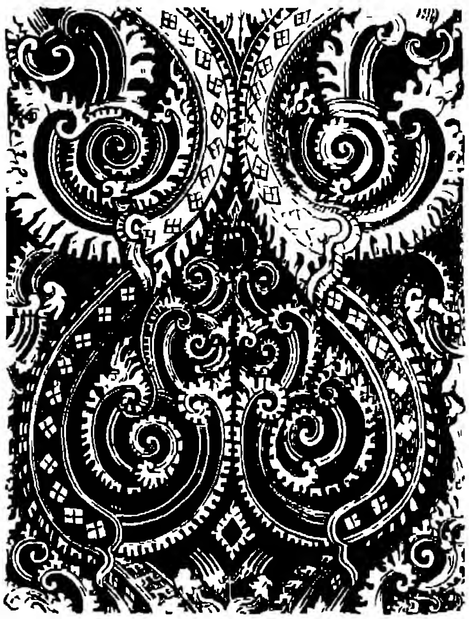


Fig. 12.—Ornamental Work on Stieng Quiver.

more wonderful in its way than the magnificent temple of Ongkor Vaht, on the northern shores of Lake Toulé-sap. It is noteworthy that the bas-reliefs and other figures on these monuments are of the same type as the present Cambojan race, with the same regular features, full beard,

Fig. 13.—Ornamental Work on Stieng Quiver.

and even their very dress, arms, and musical instruments. Traditions of this early civilisation still linger amongst the surrounding Khmêr tribes, many of whom, such as the Stîengs, Kings, and Chams, possess natural endow-

ments of a high order, cultivate their lands with great intelligence, are skilful workers in metals, and betray extreme taste in their decorative art. In the *Tour du Monde* for May 15, 1880, Dr. Harmand figures two native pipes and a quiver of a Stieng tribe, whose forms and arabesque designs are supremely beautiful (see Figs. 11, 12, and 13). "Their artistic instincts," this observer remarks, "are more developed and especially more original [than those of their Laos neighbours]. From them I have procured various objects betraying a refined taste, and woven fabrics with simple designs and well-harmonised colours." Amongst them there is prevalent a curious system of writing, at first sight somewhat suggestive of the Irish Ogham, but of a far more primitive character. It consists of a series of notches, varying in size and number, cut on both edges of a bamboo planchette, which is generally set up as a sort of public notice at the entrance to the villages. Thus a row made up of eight large, eleven medium-sized, and nine small notches was explained to mean "Our village contains eight men, eleven women, and nine children." It is evident that in a system of this sort as wide a scope must be left to the imagination as in the hypothetical primitive speech, in which broken utterances are largely supplemented by signs and gesture. A. H. KEANE

(*To be continued*)

GEOLOGY OF BOSNIA AND HERZEGOVINA[1]

AMID the conflict of political parties, the jealousies of rival powers, the rumours of renewed dispeace among the nations, and the smouldering embers of war that seem ready at any moment to burst forth into renewed conflagration, it is a relief to turn to a volume in which the Austrian Government has just shown to the world one of the first uses to which she has put her new acquisitions in the East. Nothing could have been more quietly and unostentatiously done, and nothing could show a more enlightened and humanising policy than the action which is modestly described in the volume before us. The story is briefly told by the Ritter von Hauer in an introductory note. It appears that immediately after the pacification of the occupied provinces of Bosnia and Herzegovina the Director of the Geological Institute at Vienna addressed to the Minister of Public Worship and Instruction (under whom the Geological Institute is placed) a letter in which he pointed out the desirability of expanding the pacific mission on which the country had entered in these provinces by organising a geological survey of them under the guidance of the Geological Institute. His representations were acceded to, and on March 9, 1879, he received instructions to commence a geological reconnaissance of the provinces with detailed investigation of such localities as might be found of sufficient importance. The task was to be undertaken conjointly by the Geological Institutes in Vienna and Buda-pest. The Director was requested as soon as possible to submit a plan of survey with proposals as to the number of geologists to be detailed and the individuals most competent for the exhaustive discharge of the duties required; and he was further instructed to put himself in direct relations with the Hungarian Geological Institute with a view to a proper sub-division of the work. Ritter von Hauer had no difficulty with one part of his instructions. Two of his staff, Dr. F. von Mojsisovics and Dr. E. Tietze, had already signified their wish to undertake the work, and Dr. Bittner expressed his desire to share in it. After some delay the Hungarian Institute made known its inability, from want of a sufficient staff, to take part in the intended survey. At last, on March 23, Director Von Hauer was able to announce to the Ministry that he was ready to begin operations. He proposed that as the work would naturally fall into two sections, (1) the preparation of a geological sketch-map of the whole occupied Provinces, and (2) a special detailed investigation of localities affording indications of salt, coal, or ores, it would be desirable to arrange the officers employed into two divisions. For the preparation of the map he suggested that four geologists should be employed, which, estimating the area to be surveyed at 1000 square German miles, would give 250 square miles to each surveyor. He recommended for this duty the three gentlemen above-named, and added the name of Prof. Hornes of Graz as the fourth, should the Hungarian Geological Institute have no other to propose. It was of course impossible that these officers, intrusted with the task of rapidly traversing the country and seizing on the salient features of its geological structure, should have time to halt anywhere long enough to make detailed investigations for useful minerals. This part of the duties however was one in which the services of the Hungarian Geological Institute might be especially useful, seeing that the distribution of ores in the Hungarian territory bore the closest analogy to that in Bosnia. The name of Herr F. Herlich of Klausenberg was accordingly suggested as one of the most competent persons to be intrusted with this part of the survey. It was further represented that the interesting and important coal and salt-spring region of Dolnj-Tuzla would be most fittingly explored by Herr Bergrath K. M. Paul, well known for his intimate acquaintance with the mineral tracts of Slavonia, Croatia, and the northern slopes of the Carpathian Mountains. Some further suggestions as to additional assistants were made. At last on April 7, 1879, the scheme of operations received the sanction of the Minister of Public Worship and Instruction.

By the beginning of May Herr Paul had broken ground in Bosnia. Before the end of the same month Herren von Mojsisovics, Tietze, and Bittner were likewise in the field, and undertook by themselves the whole burden of the map. In about three months the traverses for the construction of the map were completed, and the geological structure of a hitherto unexplored region of 1000 square German miles was added to our knowledge of the geology of Europe. One is at a loss whether most to admire the breadth of view which conceived and planned this first utilisation of an annexed territory, or the zeal and capacity which so rapidly carried out and completed the conception.

The *Jahrbuch der k. k. Geologischen Reichsanstalt* is one of the best-known and most useful geological journals in existence. The present number considerably exceeds the usual size of the periodical, since it is expanded by containing the reports of the geologists upon the recent survey of Bosnia-Herzegovina. Dr. von Mojsisovics takes West Bosnia and Turkish Croatia. In his report, after acknowledging assistance received in the country and enumerating the literature of the subject, in which the work of the veteran Ami Boué stands in the foremost place, the author proceeds to give a general outline of the topography and geology of the region examined by him. Most of his survey was done on horseback. He chose various traverses of the country, noting down by the way his observations upon the general map of Europe on a scale of $\frac{1}{300000}$, published by the Military Geographical Institute of Vienna. The first section of his report is devoted to geological topography, and includes some interesting information regarding what has been termed the "oriental fixed land"—an ancient island or nucleus round which, in the Balkan Peninsula, the Lias and more recent formations have been ranged. The second section treats of the geological formations in stratigraphical order, the more important being Triassic, Jurassic, Cretaceous, and Flysch, the last-named belonging partly to the Cretaceous

[1] *Jahrbuch der k. k. Geologischen Reichsanstalt*. Band xxx. Heft ii., containing "Grundlinien der Geologie von Bosnien Hercegovina," von Dr. E. v. Mojsisovics, Dr. E. Tietze und Dr. A. Bittner, mit Beiträgen von Dr. M. Neumayr und C. v. John. Vienna, 1880. The work is also published separately by Holder of Vienna, with a preface by Dr. v. Hauer.

and partly to the Eocene system. Among the younger formations the author devotes a couple of pages to sub-aerial deposits, including the results of the superficial weathering of rocks and the formation of "eluvial" accumulations. The third section describes the geological structure of different traverses of the country, and localities of geological interest, while a supplement contains observations on the mineral resources of the ground reported upon.

Dr. Tietze describes in a similar methodical way the geology of East Bosnia, while Dr. Bittner takes the Herzegovina and the south-east part of Bosnia. These reports are full of interest, especially in relation to the Cretaceous and Tertiary geology of the east of Europe. To some of the questions discussed in them we may return on another occasion. Though the geologists in their rapid marches had little time to collect specimens they nevertheless found opportunity to carry off some rocks and fossils which were found of sufficient importance to deserve special description. Herr C. v. John gives a report on some crystalline rocks of the Provinces, including granite, older plagioclase rocks, younger diabases, diorites, and similar rocks from the Flysch, gabbros, serpentines, eclogites, with trachytic and andesitic lavas. Dr. Neumayr describes a series of brackish-water shells from the Tertiary formations of the Provinces.

The Geological Institute of Vienna may be congratulated on the signal success of its well-planned and admirably-conducted enterprise. Rarely has so compendious a body of detailed information in geology been so rapidly accumulated and so promptly published. Ritter von Hauer's preface is dated March 1, 1880—that is within a year from the time when his proposal for the Survey was laid before the Austrian Government. These few months sufficed for the field-work, for the elaboration of the reports, and for the preparation of the map and engravings. The Reports form a volume of 333 closely-printed octavo pages. The map is issued in one sheet on the scale of $\frac{1}{576000}$, with twenty-one colours.

ARCH. GEIKIE

MICHEL CHASLES

Born November 15, 1793; *Died December* 18, 1880

"KNOW ye not that there is a prince and a great man fallen this day?" might well have been the thought of the President Becquerel when he announced to the Academy on the 20th ult. that Chasles was dead. To many the man who had surpassed in age Leibnitz by seventeen, Euler by eleven, Lagrange by ten, Laplace and Gauss by nine, and Newton by two years, was a "venerabile nomen," but yet a "nomen" only.

As far back as the present generation can remember Chasles has been a prince of geometers, and it has come upon many of us as a surprise to hear that he was still walking and working in our midst. A few years back a telegram was sent him from Boston conveying congratulations, and expressing the hope that the illustrious mathematician might see the close of the present century, in which event he would have surpassed the years of Pythagoras. Length of days is not always a boon, but Chasles's was a pleasant old age, and he died in harness; in such a case he might say with one of old, "nihil habeo quod incusem senectutem." "La vie de M. Chasles a été heureuse et simple; il a trouvé dans la Science, avec les plus grandes joies, une gloire qui sera immortelle, et dans la vive affection de ses amis, dans leur assiduité empressée aux réunions où il les conviait avec une grâce si aimable, dans leur respectueuse déférence en toute circonstance, la consolation de sa vieillesse."

Born at Epernon (Eure-et-Loir), he entered the École Polytechnique in 1812. At this early date he would communicate to students in the rival colleges the problems and exercises of the week, asking in return the questions proposed by their masters: "Dans cet échange organisé par le jeune lycéen, on peut croire aisément que le futur géomètre avait souvent la meilleure part." After taking his place in the defence of Paris in 1814 he passed out in engineering, but he re-entered the school in 1815. And this is the reason. Chasles was on the point of leaving for Chartres to show his uniform and to bid farewell to his mother before going to Metz, when he was waited on by the father of one of his comrades. "Mon fils," said the father, "est le premier des élèves qui n'ont pas obtenu de place; vous avez hésité, je le sais, à accepter l'épaulette; votre refus aurait assuré à votre camarade une carrière qui lui plaît et pour laquelle j'ai fait les derniers sacrifices; il m'est impossible de les continuer pour lui en préparer une autre." Chasles made no reply: he went to Chartres; on his arrival his choice was made, and he told his mother he would stay with her. The army lost him as an officer, the world gained him as a geometer. On finally leaving the establishment, in spite of the high position he held amongst his companions, he voluntarily renounced public employment (Larousse states however, "Fut agent de change et plus tard aux affaires pour les sciences") and went to Chartres, where he spent some ten years. He was working quietly however. "Toujours passionné pour la géométrie, il résolvait de beaux problèmes, comme au collège, trouvait chaque jour d'élégants théorèmes, inventait des méthodes générales et fécondes, sans attirer l'attention des maîtres de la science et sans y prétendre. 'Que de talent perdu!' disaient les plus bien-veillants, sans songer même à traiter d'égal ce jeune homme obstiné à approfondir les théories élémentaires et qui bientôt peut-être devait, par elles, s'élever bien au-dessus d'eux." Elected a Corresponding Member of the Academy in 1839 ("decorated" the same year), he was made "Professeur de Machines et de Géodésie" at the École Polytechnique, in succession to Savary in 1841. This chair he occupied for ten years, when, in consequence of some alterations ("profondes et très regrettables"[1]), he sent in his resignation, and ever afterwards did all in his power to combat these, as he thought, dangerous reforms. His affection however continued unabated. "C'est ainsi qu'il acceptait avec tout d'empressement la présidence du Comité de la Société amicale des Anciens Élèves; c'est ainsi qu'il entrait au conseil de perfectionnement, et que, tout récemment encore, malgré son grand âge, il acceptait le renouvellement de son mandat, avec le désir, disait-il, de continuer jusqu'à son dernier souffle à entretenir ce foyer de travail, d'honneur et de dévouement au pays." With the ardour which so distinguished him, M. Chasles had undertaken to write a history of the school; an extract from this history he recently published: "Exposé historique concernant le Cours de Machines, dans l'Enseignement de l'École Polytechnique" (see notice in NATURE, vol. xxiii. p. 75). M. Laussedat informs us that the veteran's wish is in great part attained, and that it was with great pleasure Chasles learned before his death that the *Journal de l'École Polytechnique* is to be revived, and that the revision of the "programmes de l'enseignement" was decided upon. In France the professorial chairs are *special*.[2] Poinsot was, for some years, desirous that a chair should be appointed for the Modern Geometry, and in 1846 this chair was created by the Faculté des Sciences, and Chasles was elected to be the first occupant. In 1851 he was elected a Member of the Academy, and in the same year, as above stated, gave up his appointment at the Polytechnic. In 1854 he became Foreign Member of our Royal Society, in 1865 he was awarded the Copley medal, and in April, 1867, he was elected the first (and for some time the only) Foreign Member of the London

[1] Note, p. 583, to the admirable "Discours d'Inauguration de Cours de Géométrie Supérieure de la Faculté des Sciences de Paris" (December 22, 1846) which follows the second edition of the "Traité de Géométrie Supérieure" (1880).

[2] "Toutes les chaires ont un titre spécial." "Rapport sur les Progrès de la Géométrie," Paris, 1870, pp. 219, 170.

Mathematical Society. His honours of membership were numerous, and are printed on the title-pages of his works. The Pascal-Newton controversy has already been alluded to in these pages, and we willingly leave it here untouched.

"M. Chasles a poursuivi son œuvre sans interruption depuis sa sortie du Lycée jusqu'à l'âge de quatre-vingt-sept ans. Soixante-huit années séparent la première note de l'élève Chasles, insérée dans la *Correspondance sur l'École Polytechnique*, du dernier mémoire présenté à l'Académie des Sciences. Tous les géomètres, sans distinction de nationalité ni d'école, se sont inclinés devant ce vénérable vieillard; tous ont admiré sa puissance d'invention, sa fécondité, que l'âge semblait rajeunir, son ardeur, et son zèle, continués jusqu'aux derniers jours."

A mere recital of the titles of M. Chasles' numerous papers would fill several columns. In the "Catalogue of Scientific Papers" will be found the titles of 177, and from the slight examination we have been able to make we have little doubt that the number published since 1873 would bring the total to nearly 240. The subjects range over curves and surfaces of the second and of any degree, geometry, mechanics (and attractions), history, and astronomy. Amongst his earliest papers are those which were translated by the present Bishop of Limerick in 1841, under the title "Two Geometrical Memoirs on the General Properties of Cones of the Second Degree, and on the Spherical Conics." "These possess strong claims on the attention of mathematicians, whether they are considered merely as exercises of pure geometry, exhibiting its elegance and power in a remarkable degree, or as a rich and early contribution to the theory of spherical curves."

Chasles himself remarks in his *Rapport*[1] (which perhaps furnishes the best key to his writings), "On peut s'étonner que, jusque vers la fin du premier tiers de ce siècle, on n'ait eu l'idée d'étudier ni les propriétés des cônes du second ordre qui servent à engendrer les coniques, ni celles des courbes qui tiennent sur la sphère le rang des coniques sur le plan" (p. 75).

In reply to the question, "On demande un examen philosophique des différentes méthodes employées dans la géométrie récente et particulièrement de la méthode des polaires reciproques," was written, "Mémoire de Géométrie sur deux Principes généraux de la Science, la Dualité, et l'Homographie" (January, 1830, to the Académie Royale of Brussels), preceded by some historical researches. This work subsequently took the form of the famous "Aperçu historique sur l'Origine et le Developpement des Méthodes en Géométrie . . . suivi d'un Mémoire . . . sur deux Principes généraux . . . et l'Homographie." This work appeared in 1837, and having become exceedingly scarce, was reprinted verbatim in 1875, with the addition of a short preface giving a brief historical account of the book. In the *Rapport* (p. 80) we are told "c'est cette troisième partie" (the memoir on Duality and Homography) "qui à donné lieu à la composition de l'ouvrage. La théorie des figures homologiques et celle des polaires reciproques qui sont la base des beaux travaux de l'illustre Général Poncelet donnèrent une heureuse impulsion aux recherches de pure géométrie." These two methods were susceptible, he says, of generalisation, and the progress of the science demanded it. The *Aperçu*, which has been translated into German (except the third part) by Sohncke, is a perfect mine of geometrical facts, and is to the present day a high authority on the subject of which it treats. In some places too great reliance on Montucla (see Dr. Allman on "Greek Geometry from Thales to Euclid," p. 171, cf. also p. 202), and in others non-acquaintance with German ("nous éprouvons un vif regret de ne pouvoir citer ici leurs ouvrages, qui nous sont inconnues, par suite de notre ignorance de la langue dans laquelle ils sont écrits," p. 215) may slightly detract from its merits, but after all deductions it exhibits a vast amount of research and originality, and well merits the title of *ouvrage classique*.[1]

The appointment to the Chair of Modern Geometry necessitated a course (or courses) of lectures, and in 1852 these were embodied in the "Traité de Géométrie supérieure," "an elaborate and masterly treatise," which of late years has been rarely attainable, and only at a very high price. M. Chasles, hardly two months before his death, had the satisfaction of seeing a second edition, accompanying which is (pp. 547-585) the excellent "Discours d'Inauguration" (referred to above). The three fundamental principles of this work are "Anharmonic Ratio of Four Points," "Homographic Divisions," and "Involution" (*Rapport*, p. 220).

In 1865 appeared the first volume of the "Traité des Sections coniques, faisant suite au Traité de Géométrie supérieure." As its title indicates, constant application is made in it of the principles of pure geometry unfolded in the earlier work. It thus differs considerably not only from analytical treatises, but from geometrical treatises also. "Ces trois théories primordiales s'appliquent avec une extrême facilité à toutes les recherches concernant les sections coniques" (*Rapport*, pp. 266-9).

Mathematicians have long looked for a second volume, materials for which have appeared in the *Comptes rendus*. In the *Rapport* (pp. 257-266) will be found an account of the method of *geometrical substitution* and a definition of the *elements* (or *characteristics*) of a system of conics (*Comptes rendus*, 1864-7). Numerous applications are made of this remarkable theory (for further accounts the English student may refer to Dr. Salmon's "Higher Plane Curves," pp. 360, &c., and "Conics," p. 368; see also later papers in the *Comptes rendus*, vol. lxxviii.[2] p. 577, &c., vol. lxxxv. p. 362, pp. 460-6).

We must now go back to the year 1863, when Chasles published his "Les trois Livres de Porismes d'Euclide, rétablis pour la première Fois, d'après la Notice et les Lemmes de Pappus, et conformément au Sentiment de R. Simson, sur la Forme des Enoncés de ces Propositions." In 1838 he had contributed a paper, "Sur la Doctrine des Porismes d'Euclide," to Quetelet's *Corresp. Math.* x. (pp. 1-23). We must content ourselves with referring to the *Rapport*, pp. 155, 233-42; the *Aperçu*, pp. 39, &c. (He cites Montucla as to the profoundness of the Porisms, gives high praise to Simson, and shows that there is in Pappus's Lemmas what is in effect the projective property of the anharmonic ratio of four points). The publication of this work led to a short controversy with M. P. Breton ("Question des Porismes—notices sur les débats de priorité auxquels a donné lieu l'ouvrage de M. Chasles sur les porismes d'Euclide," Paris, 1865; and a second part, Paris, 1866). M. Chasles comments on these in the *Rapport* (cf. reff. above).

We turn now for a moment to the subject of attraction. "La question de l'attraction presenta-t-elle à l'auteur sous plusieurs points de vue, qui donnèrent lieu à divers mémoires et s'étendirent même au problème général de l'attraction d'un corps de forme quelconque" (*Rapport*, p. 101); on p. 103 he gives a history of Maclaurin's theorem (of which Todhunter—"History of the Theories of Attraction," &c., vol. i. 260, writes: "Chasles is correct"); on p. 105 we read: "Mais il restait toujours à désirer une démonstration directe et rigoureuse du théorème de Maclaurin," and he cites an extract from Poinsot's report on his paper (*Mémoires* par divers Savants, t. ix. 1846). "Ce mémoire remarquable nous offre un nouvel exemple de l'élégance et de la clarté que la géométrie peut répandre sur les questions les plus

[1] Pp. 72-156, 220-280, contain an account of the author's own contributions to geometry.

[1] De Morgan says, "A work of great importance in the historical point of view."

[2] "Considérations sur le caractère propre du principe de correspondance." "S'applique avec une très grande facilité, à une infinité de questions."

obscures et les plus difficiles" (*Comptes rendus*, t. vi 1838, pp. 808–812)

Thus, the first *synthetic* solution (of General Sabine's address on presenting the Copley Medal) was published, if we mistake not, in 1837 M Bertrand, in his *éloge* of Lamé (January 28, 1878, *Mémoires* de l'Académie des Sciences), says "M. Chasles obtenait, en la transportant à la théorie si souvent étudiée de l'attraction des ellipsoides, des démonstrations et des résultats admirés comme un modèle d'élégance et de généralité."

We have no space left, having perhaps already dwelt too much in detail upon the complete works, to give an account of the numerous papers we referred to above This is the less necessary as the results of many are already incorporated in the larger works We must however just mention the important mechanical principle founded upon the proposition "quand deux polygones égaux sont placés d'une manière quelconque dans un plan, il existe toujours un point du plane qui est également distant de deux sommets homologues quelconques des deux polygones, le point est semblablement placé par rapport aux deux polygones"

The applications of this, under Poncelet's form of enunciation, are fully treated of by Richard in his "Note sur un nouveau principe de cinématique sur son emploi et sur la Théorème de M Chasles" (Paris, 1856)

In the closing lines of the *Rapport* M Chasles indignantly condemns the modern system which has for its supreme and immediate object *des applications pratiques*; and which is "caracterisée suffisamment par l'idée fatale de *bifurcation*" These remarks we pass over, but gladly draw attention to a wish which he strongly expresses, viz that a defect should be remedied by the creation of two chairs, one for "Géométrie infinitésimale et analytique," and the other for "Analyse transcendante" If these chairs do not now exist, it would be a fitting compliment to his memory to establish one or both One other wish we have which we repeat, and that is, following the fashion of the time, that a collected edition of his papers be issued, for at present they are scattered over a very wide area

In this notice we are indebted to the funeral speeches pronounced over M Chasles's grave (*Comptes rendus*, xci No. xxv., December 20, 1880) which, and M. Chasles's own remarks, we have freely cited in their original language, thereby securing conciseness of expression.

We must however linger no longer by the grave, but turn to the "living present," after repeating M. Dumas's last words, "Adieu, Chasles, adieu!" R TUCKER

PROF. HUXLEY ON EVOLUTION[1]

II

IF all the Mammalia are the results of a process of evolution analogous to that which has taken place in the case of the Equidæ, and if they exhibit different degrees of that process, then a natural classification will arrange them, in the first instance, according to the place which they occupy in the scale of evolution of the mammalian type, or the particular rung of the "scala mammalium" on which they stand. The determination of the position thus occupied by any group may, I think, be effected by the deductive application of the laws of evolution That is to say, those groups which approach the non-mammalian Vertebrata most closely, present least inequality of development, least suppression, and least coalescence of the fundamental parts of the type, must belong to earlier stages of evolution, while those which exhibit the contrary characters must appertain to later stages.

Judged from this point of view, there can be no doubt that the Monotremes embody that type of structure which constitutes the earliest stage of mammalian organisation —

1. The mammary glands are devoid of teats, and thus the essential feature of the mammal could hardly be presented under a simpler form

2 There is a complete and deep cloaca, as in Vertebrata lower in the scale.

3 The openings of the ureters are *hypocystic*—that is to say, they open, not into the bladder of these animals, but behind it, into the dorsal wall of the genito-urinary passage. As this answers to the neck of the allantois, the ureters of the Monotremes retain their primitive embryonic position.

4. There is no vagina apart from the genito-urinary passage, and the oviducts are not differentiated into distinct uterine and Fallopian regions

5 The penis and the clitoris are attached to the ventral wall of the cloaca

6. The epiphyses of the vertebræ are but slightly, or not at all developed[1]

7 The malleus is relatively very large, and the "processus gracilis," which is singularly long and strong, passes between the tympanic and the periotic bones to the pterygoid, with which it is firmly united Thus the palato-pterygoid apparatus is directly connected by a "suspensorium" with the periotic, as in the Amphibia and Sauropsida. As in these, the representative of the incus is extremely small and that of the stapes columelliform

8 The coracoid is complete, distinct, and articulates with the sternum

9 The hip-girdle is provided with large epipubes, and the iliac axis is inclined at a large angle to the sacral axis

10 The corpus callosum is very small.

11 There appears to be no allantoic placenta, though, from the obvious remains of the ductus arteriosus and of the hypogastric arteries, there can be little doubt that the fœtus has a large respiratory allantois It is quite possible that, with a large umbilical sac, there may be an imperfect "umbilical" placentation

But, while the *Ornithorhynchus* and the *Echidna* are thus the representatives of the lowest stage of the evolution of the Mammalia, I conceive it to be equally unquestionable that, as Haeckel has already suggested, they are greatly modified forms of that stage—*Echidna*, on the whole, representing a greater, and *Ornithorhynchus* a less, departure from the general type The absence of true teeth in both genera is an obvious sign of extreme modification. The long tongue, extraordinary external auditory passages, and relatively large convoluted brain of *Echidna*, and the cheek-pouches and horny mouth plates of *Ornithorhynchus*, are other indications of the same kind.

Hence, the primary mammals which were less modified, and the existence of which is necessarily postulated in the conception of the evolution of the group, cannot, without risk of confusion, be called Monotremata or Ornithodelphia, since in all probability they were as widely different from *Ornithorhynchus* and *Echidna* as the Insectivora are from the Edentata, or the Ungulata from *Rhytina* It will therefore be convenient to have a distinct name—*Prototheria*—for the group which includes these, at present, hypothetical embodiments of that lowest stage of the mammalian type, of which the existing Monotremes are the only known representatives.

A similar reasoning applies to the Marsupialia. In their essential and fundamental characters they occupy an

[1] Continued from p 204 By the courtesy of the Secretary of the Zoological Society we are able to give the remainder of the paper "On the Application of the Laws of Evolution to the Arrangement of the Vertebrata, and more particularly of the Mammalia," by Prof T. H Huxley, F.R S

[1] Dr Albrecht ("Die Epiphysen und die Amphiomphalie der Säugethierwirbel-körper" *Zoologischer Anzeiger*, 1879, No 18), while admitting that *Echidna* has no epiphyses, describes epiphyses of an incomplete character between the posterior twelve caudal vertebræ of *Ornithorhynchus* So far as I am aware, the memoir of which Dr Albrecht has given a preliminary notice, has not yet been published I content myself therefore with remarking that my own recent observations are in harmony with Dr Albrecht's statement

intermediate position between the Prototheria and the higher mammals

1. The mammary glands are provided with teats

2. The cloaca is so greatly reduced that it is often said to have disappeared

3. The openings of the ureters are *entocystic*—that is to say, the ureters open into what is called the "base" of the bladder in front of the narrowed "neck" by which it passes into the tubular "urethra." This means, I conceive, that, morphologically, the bladder of the Marsupial represents the bladder of the Monotreme + the anterior part of the genito-urinary passage, the so-called "trigonum," if not more, of the bladder of the Marsupial, being the homologue of that anterior segment of the genito-urinary passage of the Monotreme

4. There is a distinct and long vagina, quite separated from the cystic urethra, in the female, and the oviducts are differentiated into uterine and Fallopian portions.

5 The penis is large, and the corpora cavernosa are connected by fibrous tissue and muscles with the pelvis The spongy body has a large bifurcated bulb, and Cowper's glands are very largely developed

6. The vertebræ have distinct epiphyses

7 The malleus is small, and its connections are similar to those which it possesses in the higher mammals The incus is relatively larger, and the stapes more or less stirrup-shaped.

8 The coracoid is short, does not articulate with the sternum, and becomes ankylosed with the scapula

9. The hip-girdle is provided with epipubes, usually of large size and well ossified, and the iliac axis is inclined at a small angle to the sacral axis

10. The corpus callosum is small

11 In the few forms of which the fœtus is known there is no allantoic placenta, while the umbilical sac is so large that the possibility of the existence of a transitory umbilical placentation must be taken into account

It will be observed that in the characters 1, 2, 3, 4, 5, 6, 7, 8, and the latter part of the 9th, the Marsupials agree with the higher mammals, while in the former part of the 9th, the 10th, and the 11th, they present Prototherian characters So far, therefore, they constitute an intermediate type between that of the Prototheria and that of the higher mammals, which may be termed that of the *Metatheria*. And if there were any known animals which combined these characters, with a complete double dentition, unmodified pentadactyle manus and pes, and normal uterogestation, they would furnish us the exact transition between the Prototheria and the higher mammals, which must have existed if the law of evolution is trustworthy.

No known Marsupial, however, possesses these additional characters None has more than a single successional tooth on each side of each jaw, and, as Prof. Flower (to whom we owe the highly important demonstration of this fact) has pointed out, the question arises whether we have here a primary dentition with only one secondary tooth, or a secondary dentition with only one tooth of the primary set left I have no doubt that the answer given to this question by Prof Flower is correct, and that it is the milk-dentition of which only a vestige is left in the Marsupialia. Among existing Rodents, in fact, all conditions of the milk-dentition exist, from a number equal to that of the permanent incisors and premolars (as in the Rabbit[1]) to none at all

The same thing is observed in the Insectivora, where the Hedgehog, and probably *Centetes*, have a full set of milk-teeth, while none have yet been found in the Shrews. In these cases, it is obvious that the milk-dentition has gradually been suppressed in the more modified forms; and I think that there can be no reasonable doubt that the existing Marsupials have undergone a like suppression of the deciduous teeth, in the course of their derivation from ancestors which possessed a full set.

Again, no existing Marsupial possesses an unmodified pentadactyle pes. If the hallux is present, it presents an extensive movement in adduction and abduction, in fact, the pes is prehensile This is the case in the *Phascolomyidæ*, *Phalangistidæ*, *Phascolarctidæ*, and *Didelphidæ* The *Dasyuridæ* present the same type of pes, with the hallux reduced or suppressed Hence, considering the relations of the *Macropodidæ* and the *Peramelidæ* with the Phalangers, it seems likely that the hind foot in these groups is also a reduced prehensile pes; in which case this special modification of the foot would characterise the whole of the existing *Marsupialia*

Thirdly, the most marked peculiarities of the reproductive organs and processes in the Marsupial are in no wise transitional, but are singularly specialised characters The suspension of the scrotum in front of the root of the penis is unlike any arrangement in the higher mammals, and the development of the bulb and of Cowper's glands is in excess of anything observable in them In the female, the cystic urethra is as completely separated from the vagina as it is in the higher mammals, while the doubling of the vagina must, in my opinion, also be considered as a special peculiarity which leads from, rather than towards, the higher mammals In a Monotreme, in fact, the anterior end of the genito-urinary passage exhibits two very short dilatations or cornua, one on each side. In the middle line, a little distance behind these, the ureters open on a prominent ridge-like papilla The opening of the bladder lies in front of and below the genital cornua Now, if we compare this arrangement with that which obtains in the lower forms of the higher Mammalia, we find that the ureteric papillæ have separated laterally and moved forwards, in such a manner as to occupy the base of the bladder, and the genital cornua come to lie behind and somewhat dorsad of them At the same time a longitudinal separation has taken place between what may be called the "ureteric" region of the genito-urinary passage and the "genital" region The first is taken into the bladder and becomes connected by a longer or shorter "cystic urethra" with the latter, which is converted into the longer or shorter vagina In the Marsupial the same general modification has taken place, but the "genital cornua" become immensely elongated, and give rise to the so-called "double" vagina

Lastly, the marsupium, where it exists, is a no less special feature of the Marsupialia, and, like the peculiarities of the female genital organs, appears to be related with the abnormally early birth of the fœtus Among the higher Mammalia, it is well known that the fœtus is born in a relatively much earlier state in some cases than in others, even among closely allied species. Thus Rabbits are born hairless and blind, while Hares are born hairy and with their eyes open I think it probable, from the character of the pes, that the primitive forms, whence the existing Marsupialia have been derived, were arboreal animals, and it is not difficult, I conceive, to see that with such habits it may have been highly advantageous to an animal to get rid of its young from the interior of its body at as early a period of development as possible, and to supply it with nourishment during the later periods through the lacteal glands, rather than through an imperfect form of placenta.

However this may be, the characters of the existing Marsupialia leave no doubt on my mind that they are greatly modified members of the metatherial type, and I suspect that most, if not all, of the Australian forms are of comparatively late origin. I think it probable that the

[1] The deciduous molars and the posterior deciduous upper incisors of the Rabbit have been long known But I have recently found that unborn Rabbits possess, in addition, two anterior upper and two lower deciduous incisors Both are simple conical teeth, the sacs of which are merely embedded in the gum. The upper is not more than one-hundredth of an inch long, the lower rather larger It would be interesting to examine fœtal Guinea pigs in relation to this point, at present they are known to possess only the hindmost deciduous molars, so far agreeing with the Marsupials.

great majority of the Metatheria, of which I doubt not a great multitude will shortly be discovered in Mesozoic formations, differed widely from our existing Marsupials, not only lacking the pouch, as do some existing "Marsupialia," but possessing undivided vaginæ, and probably bringing forth their young, not earlier than existing Carnivores and Rodents do, the nutrition of the fœtus during prolonged gestation being provided for, in all probability, by an umbilical placental apparatus, and its respiration by a non-placental allantois

In the remaining group of the Mammalia, hitherto spoken of as the "higher Mammalia"—

1. The mammary glands are provided with teats[1]

2 The cloaca has usually disappeared Sometimes, however (Beavers, Sloths), a shallow cloaca is present, especially in the female.

3 The openings of the ureters are always entocystic, but their position varies greatly, from close to the neck (e.g *Sorex*) to the anterior end of the bladder (e g *Hyrax*).

4. There is a distinct vagina, which is almost always undivided. The oviducts are differentiated into uterine and Fallopian portions

5 The penis is usually large, the bulb single or partially divided, and the corpora cavernosa almost always directly attached to the ischia

6 The vertebræ have epiphyses

7. The malleus is usually small, the incus relatively large, the stapes stirrup shaped

8 The coracoid is almost always much reduced, and it is ankylosed with the scapula

9 The iliac axis makes a small angle with the sacral axis, and there is no epipubis, or only a fibrous vestige of it

10. The corpus callosum and the anterior commissure vary widely In such forms as *Erinaceus* and *Dasypus* they are almost Monotreme-like

11 The fœtus is connected with the uterus of the mother by an allantoic placenta The umbilical sac varies in size, and in some lower forms (e g *Lepus*) it is, at first, highly vascular, and perhaps plays a quasi-placental part during the early stages of development

It is obvious that, in all these respects, we have the mammalian type in a higher stage of evolution than that presented by the Prototheria and the Metatheria. Hence we may term forms which have reached this stage the *Eutheria*

It is a fact, curiously in accordance with what might be expected on evolutionary principles, that while the existing members of the Prototheria and the Metatheria are all extremely modified, there are certain forms of living Eutheria which depart but little from the general type For example, if *Gymnura* possessed a diffuse placentation, it would be an excellent representative of an undifferentiated Eutherian Many years ago, in my lectures at the Royal College of Surgeons, I particularly insisted on the central position of the Insectivora among the higher Mammalia, and further study of this order and of the Rodentia has only strengthened my conviction, that any one who is acquainted with the range of variation of structure in these groups, possesses the key to every peculiarity which is met with in the Primates, the Carnivora, and the Ungulata Given the common plan of the Insectivora and of the Rodentia, and granting that the modifications of the structure of the limbs, of the brain, and of the alimentary and reproductive viscera, which occur among them, may exist and accumulate elsewhere, and the derivation of all the *Eutheria* from animals which, except for their simpler placentation, would be Insectivores, is a simple deduction from the law of evolution.

There is no known Monotreme which is not vastly more different from the Prototherian type, and no Marsupial which has not far more widely departed from the Metatherian type, than *Gymnura*, or, indeed, *Erinaceus*, have from the Eutherian type

The broadest physiological distinction between the Prototheria, the Metatheria, and the Eutheria respectively lies in the differences which the arrangements for prolonging the period of intra uterine and extra-uterine nutrition by the parent present in each The possibility of a higher differentiation of the species is apparently closely connected with the length of this period Similarly, the broadest morphological distinction which can be drawn among the *Eutheria* lies in their placentation. All forms of deciduate placentation commence by being non-deciduate, and the intimate connection of the fœtal with the maternal structures is subsequent to their loose union Hence *Eutheria*, with deciduate placentæ, are in a higher stage of evolution than those with non-deciduate placentæ

In discussing the relations of the various existing groups of the higher Mammalia with one another, it would be a mistake to attempt to trace any direct genetic connection between them Each, as the case of the Equidæ suggests, has probably had a peculiar line of ancestry, and, in these lines, Eutherian forms with deciduate placentation constitute the latest term, Eutherian forms with non-deciduate placentation the next latest, Metatherian forms the next, Prototherian forms the earliest among those animals which, according to existing definition, would be regarded as Mammals

The accompanying Table (p 230) presents, at a glance, the arrangement of the Mammalia in accordance with the views which I have endeavoured to express The sign O marks the places on the scheme which are occupied by known Mammals, while × indicates the groups of which nothing is known, but the former existence of which is deducible from the law of evolution

I venture to express a confident expectation that investigation into the Mammalian fauna of the Mesozoic epoch will sooner or later fill up these blanks But if deduction from the law of evolution is to be justified thus far, it may be trusted much farther If we may confidently expect that *Eohippus* had a pentadactyle claviculate ancestor, then we may expect, with no less confidence, that the *Prototheria* proceeded from ancestors which were not mammals, in so far as they had no mammary glands, and in so far as the mandible was articulated with a quadrate bone or cartilage, of which the malleus of the true mammal is the reduced representative Probably also the corpus callosum had not appeared as a distinct structure

Our existing classifications have no place for this "sub-mammalian" stage of evolution (already indicated by Haeckel under the name of *Promammalia*) It would be separated from the Sauropsida by its two condyles, and by the retention of the left as the principal aortic arch; while it would probably be no less differentiated from the Amphibia by the presence of an amnion and the absence of branchiæ at any period of life I propose to term the representatives of this stage *Hypotheria*, and I do not doubt that, when we have a fuller knowledge of the terrestrial Vertebrata of the later palæozoic epochs, forms belonging to this stage will be found among them. Now, if we take away from the Hypotheria the amnion and the corpus callosum, and add the functional branchiæ—the existence of which in the ancestors of the Mammalia is as clearly indicated by their visceral arches and clefts, as the existence of complete clavicles in the ancestral Canidæ is indicated by their vestiges in the dog—the Hypotheria, thus reduced, at once take their place among the Amphibia. For the presence of branchiæ implies that of an incompletely divided ventricle and of numerous aortic arches, such as exist in the mammalian embryo, but are more or less completely suppressed in the course of its development

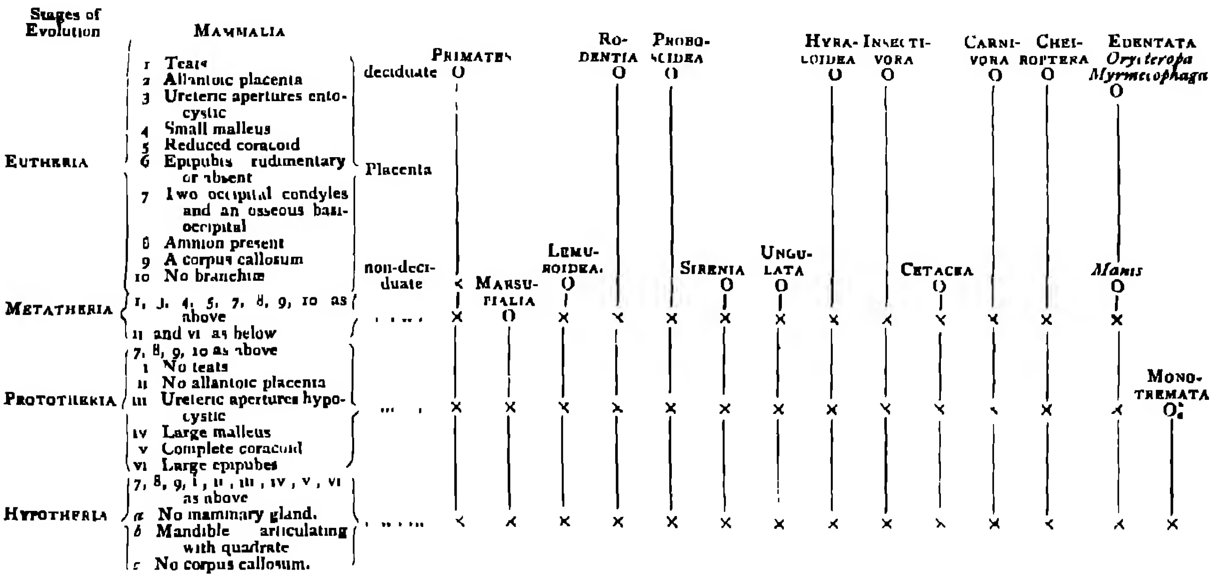
[1] The only exception known to me is the Cape Mole (*Chrysochloris*), which, according to Peters, has none

Thus I regard the Amphibian type as the representative of the next lower stage of vertebrate evolution; and it is extremely interesting to observe that even the existing Amphibia present us with almost every degree of modification of the type, from such forms as the oviparous, branchiate, small-lunged *Siredon* and *Menobranchus*, which stand in the same relation to it as *Gymnura* to the Eutheria, to the exclusively air-breathing Salamanders and Frogs, in which the period of intraovular development, either within the uterus itself or in special receptacles, may be as much prolonged as it is in the Mammalia.

A careful study, on full materials, of the development of the young of such forms as *Hylodes* will probably throw great light on the nature of the changes which ended in the suppression of the branchiæ, and the development of the amnion and of the extra-abdominal part of the allantois in the fœtus of the higher Vertebrata.

The recent researches of Boas[1] on the structure of the heart and the origin of the pulmonary arteries of *Ceratodus* fell into my hands when I happened to be working afresh at the subject, and had arrived, so far as the heart is concerned, at results which are entirely confirmatory of his. This wonderful creature seems contrived for the illustration of the doctrine of evolution. Equally good arguments might be adduced for the assertion that it is an amphibian or a fish, or both, or neither—the reason of this being that, as it appears to me, *Ceratodus* is an extraordinarily little modified representative of that particular stage of vertebrate evolution of which both the typical Fishes and the typical Amphibia are special modifications. I think it will be convenient to have a name for the representatives of this stage, and I propose that of *Herpetichthyes*.

If we were to take away from *Ceratodus* the membrane-bones of the heart and the pneumatocœle, and slightly simplify the structure of the heart, the result would be an animal which would undoubtedly be classed among the *Chimeroidei*, and if, in such a Chimæroid, the lamellar septa of the branchiæ were not reduced, as they are in the *Chimeroidei*, while the opercular fold remained undeveloped, the product would be a little modified representative of the Selachian group, to which, among actually known forms, *Heptanchus* and *Cestracion* present the nearest approximations. Vertebrated animals in this stage of evolution may be termed *Chondrichthyes*.



Suppose the limbs and the genital ducts of the *Chondrichthyes*-stage to be undeveloped, and let the two nasal sacs be represented by a partially divided sac with a single external aperture, the result will be a still lower grade of vertebrate life, which may be termed *Myzichthyes*, represented only by the greatly modified Lampreys and Hags of the existing fauna.

Finally, let the head retain its primitive segmentation, and the heart its primitive character of a contractile tube, and we reach, in the *Hypichthyes*, a stage of simplification of the vertebrate type, from which it would be difficult to remove any essential feature without reaching a point at which it is questionable whether an animal should be called "vertebrate." This stage is at present represented only by a singularly modified form, the living *Amphioxus*.

Thus, in the order of evolution all the Vertebrata hitherto considered may be arranged in nine stages:—1, that of the *Hypichthyes*; 2, that of the *Myzichthyes*, 3, that of the *Chondrichthyes*; 4, that of the *Herpetichthyes*; 5, that of the *Amphibia*; 6, that of the *Hypotheria*, 7, that of the *Prototheria*; 8, that of the *Metatheria*, and, 9, that of the *Eutheria*. All these stages, except that of the *Hypotheria*, are represented by existing groups of vertebrated animals, which, in most cases, are composed of greatly modified forms of the type to which they belong, only the Amphibia and the Eutheria exhibiting near approximations to the unmodified type in some of their existing members.

It will be observed that I have omitted to mention the Ganoid and the Teleostean Fishes and the Sauropsida. I have done so because they appear to me to lie off the main line of evolution—to represent, as it were, side tracks starting from certain points of that line. The Ganoidei and the Teleostei I conceive to stand in this relation to the stage of the Herpetichthyes, and the Sauropsida to the stage of the Amphibia.

There is nothing, so far as I can see, in the organization of the Ganoid and Teleostean fishes which is not readily explicable by the application of the law of evolution to the Herpetichthyes. They may be interpreted as effects of the excessive development, reduction, or coalescence of the parts of a Herpetichthyan.[1]

[1] "Ueber Herz und Arterienbogen bei *Ceratodus* und *Protopterus*," *Morph. Jahrbuch*, 1880.

[1] That the heart of *Butirinus* affords a complete transition between the characteristically Ganoid and characteristically Teleostean heart, has recently been proved by Boas (*Morphol. Jahrbuch*, 1880). Thus the last remnant of the supposed hiatus between the Ganoids and the Teleostean vanishes.

Similarly, the suppression of the branchiæ, the development of an amnion, and of a respiratory extra-abdominal allantois, and that enlargment of the basioccipital relatively to the exoccipitals which gives rise to a single skull-condyle, is all the change required to convert an Urodele amphibian into a Lizard It is needless to recapitulate the evidence of the transition from the Reptilian to the Bird type, which the study of extinct animal-remains has brought to light

The scheme of arrangement of the Vertebrata which naturally flows from the considerations now brought forward will stand thus —

Stages of Evolution	Representative Groups		
9 *Eutheria*	*Monodelphia* O		
8. *Metatheria*	*Marsupialia* O		
7 *Prototheria*	*Monotremata* O		
6. *Hypotheria*	×	*Sauropsida* {*Aves*, *Reptilia*} O	
5 *Amphibia*	*Amphibia* O	×	
4 *Herpetichthyes*	*Dipnoi* O	×	*Osteichthyes* {*Ganoidei*, *Teleostei*} O
3 *Chondrichthyes*	*Chimaeroidei* O		×
	Selachii O		×
2 *Myzichthyes*	*Marsipobranchii* O	×	×
1 *Hypichthyes*	*Pharyngobranchii* O	×	×

It appears to me that everything which is at present known respecting the Vertebrata of past epochs agrees with the assumption that the law which expresses the process of ancestral evolution of the higher Mammalia is of general application to all the Vertebrata If this is admitted, I think it necessarily follows that the Vertebrata must have passed successively through the stages here indicated, and that the progress of discovery, while it will obliterate the lines of demarcation between these stages, and convert them into a continuous series of small differentiations, will yield no vertebrate form for which a place does not exist in the general scheme

NOTES

Dr. John Stenhouse, F R S, died on December 31, in the seventy-second year of his age. He was a native of Glasgow, where he was educated and long resided A pupil of Graham and of Liebig, he devoted all his time to research work in the domain of organic chemistry He was a Royal Medallist of the Royal Society, LL.D of Aberdeen, and one of the founders of the Chemical Society On removing to London he was appointed Lecturer on Chemistry in St. Bartholomew's Hospital, London, but was obliged to resign in 1857, owing to a severe attack of paralysis. This however did not deter him from continuing his scientific studies, which were a labour of love to him He was the inventor of the charcoal respirator, of the charcoal ventilator for sewers, and of a process for rendering fabrics waterproof by means of paraffin In 1865 he succeeded Dr Hofmann as non-resident assayer to the Royal Mint, but was deprived of the appointment when the office was abolished by Mr. Lowe in 1870.

On the 3rd inst Mr John Thomas Towson died at his residence in Liverpool, in his seventy-seventh year. Mr. Towson was connected with the early history of photography, but in 1846 he devoted his thoughts to navigation, especially to determining the quickest routes across the ocean to distant countries. With this object he constructed a set of tables for facilitating the practice of great circle sailing, and at the British Association in 1854 Mr Towson aided Dr. Scoresby in directing the attention of the scientific section to the importance of investigating more fully the subject of the deviation of the compasses on board iron ships The result of this discussion was the formation of the Liverpool Compass Committee The observations and the deductions resulting from them were embodied in three reports, "presented to both Houses of Parliament by command of Her Majesty." In 1863 Mr. Towson was instructed by the Board of Trade to prepare a manual on the deviation of the compass, which was subsequently published at the expense of the Board, under the title of "Practical Information on the Deviation of the Compass; for the use of Masters and Mates of Iron Ships"

We are glad to learn that Prof. MacOwan, late of Gill College, Somerset East, has accepted the post of Director of the Botanic Garden, Cape Town He will also lecture at the South African College. The appointment of a man whose long and enthusiastic devotion to South African botany has earned him a wide reputation is to the credit of the Cape Government, and is of good omen for the scientific future of the Cape Botanic Garden This has never yet attained the position which it would naturally derive from the resources of one of the most interesting floras in the world

Dr. W Feddersen of Leipzig is preparing a supplement to Poggendorff's well known biographical dictionary Many of our readers will receive during the next few days circulars asking them to answer a few questions as to their scientific life and labours As the great utility of such a work lies in the completeness of the information it supplies, we trust that every one will fill up the answers to the questions as completely as is in his power, and that neither false modesty nor carelessness will create a gap in the work

Prof Corfield's lectures on Health to ladies will commence to-day, January 6, by an Introductory Lecture at 3 p m., and will be continued on Tuesdays and Thursdays at the same hour Ladies are admitted free to the Introductory Lecture.

Herr Robert Oppenheim of Berlin announces the forthcoming publication of a "Grundriss der Anatomie des Menschen," by Prof Ad Pansch of Kiel

The Reale Istituto Lombardo has awarded two sums of 1500 lire, on the Brambilla foundation, (1) to the Milanese Committee of Animal Vaccination for founding a vaccinogenic establishment in Milan, and (2) to S. Bassolini for establishing in Milan a manufactory of white lead colours and varnishes On the Fossati foundation a sum of 2000 lire has been awarded to Dr Golgi for studies on the fine anatomy of central organs of the nervous system, and 1000 lire to Drs Tenchini and Staurenghi for researches in the anatomy of the cerebellum, the Pons Tarini, &c A list of prizes now open to competition will be found in the *Rendiconti* of the Institute, vol xiii, fasc xviii The subjects have nearly all been previously published (We note that one is "Studies on the Telephone") The prizes vary in value from 500 to 4000 lire Foreigners may compete, and memoirs must be written in Italian, French, or Latin.

The Transit of Venus Commission has already met at the French Academy of Sciences, as usual under the presidency of M. Dumas, but no resolution was come to A number of scientific men have already offered themselves as observers.

Baron Nordenskjöld arrived at St Petersburg on Saturday, and was received at the station by the Swedish Ambassador and delegates from the Russian societies In the course of the day he was received at the Foreign Office, and is to be *fêted* by the Municipality and the learned societies

THE dates for some of the papers which will be read at the Society of Arts before Easter next have been announced. The following are set down for the ordinary meetings (Wednesday evenings):—January 12 A Sanitary Protection Association for London, by W. Fleeming Jenkin, F.R.S. (On this evening Prof. Huxley will preside.) January 19 Causes of Success and Failure in Modern Gold-Mining, by A. G. Lock February 23: Recent Advances in Electric Lighting, by W. H. Preece March 2 Flashing Signals for Lighthouses, by Sir William Thomson, F.R.S. March 9: Improvements in the Treatment of Esparto for the Manufacture of Paper, by William Arnot, F.C.S. March 16: The Manufacture of Aerated Waters, by T. P. Bruce Warren In the Indian Section (Friday evenings), the following will be read:—January 21: Forest Conservancy in India, by Sir Richard Temple, Bart., G.C.S.I. February 11 The Gold-Fields of India, by Hyde Clarke. March 4: The Results of British Rule in India, by J. M. Maclean. March 25: The Tenure and Cultivation of Land in India, by Sir George Campbell, K.C.S.I., M.P. The dates and Papers for the Foreign and Colonial Section (Tuesday evenings) will be:—February 1 The Industrial Products of South Africa, by the Right Hon. Sir Henry Bartle Edward Frere, Bart., G.C.B., &c. February 22: The Languages of South Africa, by Robert Cust March 15: The Loo Choo Islands, by Consul John A. Gubbins April 5 Trade Relations between Great Britain and her Dependencies, by William Westgarth For the Applied Chemistry and Physics Section (Thursday evenings) the arrangements are as follows:—January 27 A New Mechanical Furnace, and a Continuous System of Manufacturing Sulphate of Soda, by James Mactear February 24, Deep Sea Investigation, and the Apparatus used in it, by J. G. Buchanan, F.R.S.E., F.C.S. March 24 The Future Development of Electrical Appliances, by Prof. John Perry

VARIOUS earthquake shocks in Roumania, Transylvania, Hungary, &c., in the latter days of December, are reported, in Bucharest, on the 23rd of that month at 11 20 a.m., and on the 25th at 5 45 p.m., in Tultscha also, on the 25th, at 5 25 p.m. (direction north-west to south-east), in Fokschau, at 5 5 p.m., pretty strong, duration 8 sec., in Tecucui at 4 51 p.m., two strong shocks, the first lasting 2 sec., the second 4 sec., in Washui (near Tassy), a very violent undulatory shock, in Silistria (Bulgaria), at 3 22 p.m., 20 shocks lasting 1m 20s, in Homorod (Hungary), at 4.18 p.m., duration 5s, direction west to east, in Foldvar (Hungary), at 4 20 p.m., direction north-west to south-east At the same time shocks were felt at various places in the south-east of Transylvania.

IT may be useful to some of our readers to know that the Library of the Society of Telegraph Engineers and of Electricians is open to members of all scientific bodies, and (on application to the librarian) to the public generally. The library is open daily between the hours of 11.0 a.m. and 8 0 p.m., except on Thursdays and on Saturdays, when it closes at 2.0 p.m.

"WHITAKER'S ALMANAC" is undoubtedly a most useful publication, but in the larger edition there is a supplement of miscellaneous information which seems to us to require looking after. Among other things there is a variety of items more or less connected with science There is a "Scientific Summary" consisting of nine lines of introduction (in which the only geological fact mentioned is the discovery of some fossil remains in Essex), followed by selected subjects of general interest, including such items as "Steam Power in Germany," "Forests in Russia," "The World's Gold and Silver," "American Railroad Progress," all looking like so many random newspaper cuttings, but no mention of perhaps the most brilliant scientific event of the year—Mr Graham Bell's "Photophone." In another part of the supplement we have two pages on the "Progress of Astronomical Science"; why this is not included in the "Scientific Summary" the editor perhaps knows. A page is devoted to "Radiant Points of Shooting Stars," two to the "Year's Weather," three to "Earthquakes and Volcanic Eruptions," and three to "Geographical Discovery." The writer of the last-mentioned actually places Mr. Leigh Smith's yacht voyage to Franz Josef Land as "the most remarkable geographical event" of a year which witnessed the successful conclusion of Mr Joseph Thomson's remarkable African Expedition, because he thinks it opens up "a new and apparently feasible route for future Polar research:" does he not mean *search?* Evidently the supplement to this "Almanac" stands in need of editing, and as the whole work is to be reset for next year, perhaps this part will be brought up to the level of the rest of the work

THE *Annuaire* of the Bureau des Longitudes for 1881 has been issued by Gauthier-Villars As usual, it is full of information on a great variety of subjects more or less connected with science.

Land and Water states that the late Mr. Frank Buckland has bequeathed his valuable Museum of Economic Fish Culture to the nation, and on the decease of Mrs Buckland a sum of 5000*l.* will revert to the nation, to be applied for the purpose of founding a professorship of economic pisciculture in connection with the Buckland Museum and the Science and Art Department at South Kensington

A Scottish Fisheries Improvement Association has been formed for the purpose of making an effort to improve by various means the fisheries of the Scotch rivers, which have in recent years considerably deteriorated The president is the Duke of Sutherland, and the chairman of the provisional committee Mr. David Milne Home.

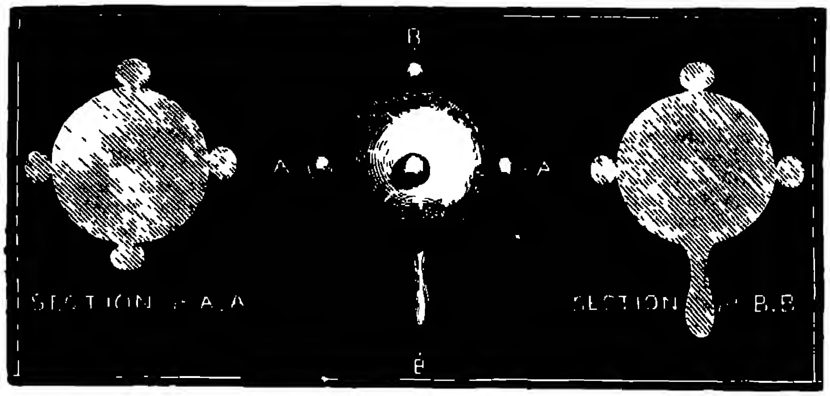
WE have received a copy of the regulations issued by the French Minister of Posts and Telegraphs for the International Congress and Exhibition of Electricity, to be opened at Paris next September Those interested in the Congress should apply to M. le Commissaire Général de l'Exposition Internationale d'Electricité, at the Palace of the Champs Élysées, porte No IV, Paris

MR INNES ROGERS, in a letter to us, calls attention to a list of bamboos published in vol i of the *Garden*, which are found to be hardy under cultivation, and to the fact that several kinds, chiefly from China and Japan, grow in Battersea Park, Kew Gardens, &c He further instances as hardy plants a Cactus from the Rocky Mountains, Begonia from the Andes, the well known *Chamærops excelsa*, *Ficus repens*, and a Mesembryanthemum acclimatised at Scilly, and believes that the fixity of continents through long geological periods would cause tropical species in spreading to adapt themselves to temperate conditions. He thinks that the Gulf Stream may have brought tropical seeds to Bournemouth, and that a most trifling change of climate would have made them thrive there

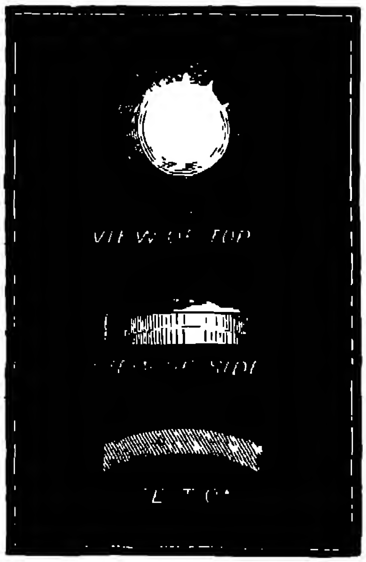
A NEW illustrated archæological review will soon be published at Naples by MM Augusto Mele and Enrico Abeniacco. It will be in French, and its title will be "Pompeii" The object of the new publication is to excite in wider circles a vivid interest for the excavations at Pompeii, Herculaneum, &c., as well as for archæology generally

IN the Austrian "Engineers and Architects Union" at Vienna, a new aeronautical department has been created, with the object of discussing and solving aeronautical problems and questions both theoretically and in practice, as well as making the necessary experiments. The application of aeronautics to meteorological science forms a special study of the department.

To the October number of *Symons's Monthly Meteorological Magazine* Col. Foster Ward writes describing some remarkable hailstones that fell during a slight thunderstorm at Partenkirchen, Bavaria, at 6 p.m. on August 21. He was on a mountain about 3000 feet above the village, and saw the cloud (a small one) pass over the valley below. There were several peals of thunder, but there was no visible lightning, owing, he concludes, to the sun's brightness. "On arriving near home, I met a friend who told me it had been hailing 'tadpoles' and 'acidulated drops.' There had been little or no rain and no visible lightning, and



the hailstones fell at intervals and about six feet apart. There were very few of them, my family only picking up twenty in a space occupied by a full-sized lawn tennis court. My son made a sketch of their shape and size, which I inclose. The greater part were of the 'tadpole' shape and were clear as glass, perfectly round, the five knobs being at equal distance from one another. The flat stones had more or less a slight nucleus of snow in the convex portion of the stone. My wife and three daughters, and two ladies staying with us, say that the stones looked just like a lady's hand looking glass, with a knob at the top and on either



side for ornament. More than twenty, perhaps thirty, were picked up of this shape. Of these about two-thirds were studded, the rest plain, with only the tail or handle, the thinnest part of it being near the body of the stone, as in sketch. The studs were all symmetrically placed. There were from three to five in each stone besides the handle. When there were less than five they occupied the same positions as if the five had been complete. In some cases the handle appeared to have been knocked off. The drops were more numerous, were *all* of same shape, convex at the top, the bottom being concave (like a small china painting palette)."

The total completion of the St. Gothard tunnel will very likely take place in July of this year; the railway is to be opened on July 1, 1882. The mail bags are even now carried through the tunnel by messengers when rough weather prevails upon the mountain. On December 21 the first mail-bag was so carried through the tunnel, and it took four hours to convey it from Göschenen to Airolo.

GEOGRAPHICAL NOTES

At the Second International Polar Conference at Berne all the leading nations of Europe were represented except England. The leading stations have been definitely decided on. Austria undertakes to establish a station in northern Novaya Zemlya, at the expense of Count Wilczek; Denmark has selected Upernivik; Germany New Georgia for the Antarctic, and Jan Mayen or East Greenland for the Arctic regions; Norway, Bossekop in Finmark; Holland the south-east coast of Novaya Zemlya, or the coast of Siberia, between the mouth of the Yenisei and Cape Taimyr; Russia has selected two stations, the mouth of the Lena and the New Siberian Islands. Even Switzerland, which has not even a sea-board, hopes to take part in the international movement, by establishing a station at Mossel Bay, in Spitzbergen. The expedition to be sent out by Italy to the Antarctic region under Lieut. Bove is to some extent connected with this scheme, and no doubt France will ultimately be compelled to take her part. As to England, there has hitherto been no sign that as a nation she is even interested in a scheme so full of important issues for science and navigation.

In a recent paper to the R. Accademia dei Lincei, Signor Guido Cora, a member of the International Polar Committee, urges the importance of the enterprise under consideration, and of Italy sharing in it. He considers the Antarctic zone as the more suitable one for Italy, as being nearer regions where Italians form a large portion of the population and conduct an extensive commerce; moreover the south has a brilliant record of geographical exploration by Italians in the sixteenth century, and the recent project of an Antarctic exploring expedition has drawn enthusiastic attention. For the temporary scientific observatory which the Italian Government is recommended to plant in 1882 (in harmony with the large scheme), S. Cora suggests one or other of three places:—1. Port Spence, on the east coast of Coronation Island in the Southern Orkneys, at about 60° 50′ S. lat., and 45° 45′ W. long. 2. Cape Lookout, on the south coast of Elephant Island, in the north-east part of the Southern Shetland group, at about 61° 17′ S. lat. and 55° 15′ W. long. (a station at either place would serve well as a base of operations for the Italian Exploring Expedition). 3. In the case of means being inadequate for a station at either of the two places named, S. Guido recommends some one of the islands close to Cape Horn. Supposing that the transport would be by a Government vessel destined to the naval station

in South America, it is calculated that the cost of the observatory would amount to 70,000 or 80,000 lire, of which 10,000 would be for instruments, and the remainder would provide three dwelling-houses, salaries of four scientists, two assistants, and two servants, food, &c. This is calculated for an absence of sixteen months, twelve of which would be occupied in observations.

THE Geographical Society's *Proceedings* this month contains three papers relating to Africa, the first of which is Sir Bartle Frere's, on Temperate South Africa. This, as now printed, embodies some useful statistical information and is illustrated by a general map of South Africa The other two papers bring some additions to our knowledge of the geography of West Africa, Mr. Comber giving a short sketch of his recent journeys in the interior of Congo, and Mr Milum an account of his travels in the Niger region. The former is accompanied by an excellent map of the neighbourhood of San Salvador and of the course of the River Congo from Stanley Pool to the sea. The final report of the Executive Committee of the African Exploration Fund is published, together with a statement of receipts and expenditure In the Geographical Notes extracts are given from a letter by Mr. Hore of Ujiji, on the long-continued rise of the waters of Lake Tanganyika, which he seems to connect with earthquake-movements. Mr. Hore is shortly about to return to England, so that we shall probably hear more on this subject before long Among the other notes we may call attention to those on the River Okavango, the survey of Eastern Palestine, and the United States' Survey operations in the neighbourhood of Behring Strait Increased attention, we note, is being paid to the proceedings of foreign geographical Societies, those of the French Society being very fully reported.

M VOSSION, who, it will be remembered, spent some time in Burmah, and not long since read papers on that country before the French Geographical Societies, has lately gone to Egypt to take up the Vice-Consulship of Khartum During his stay there he is to pay special attention to the slave trade, and to the best means of opening up commercial relations with the Sudan.

CAPT SERRA CARRACIOLI left Naples on November 23, 1880, for the Bay of Assab, having undertaken a mission, under the auspices of the Club Africano, to inquire into the possibility of developing commerce there and with the natives of the interior The Club Africano is desirous of establishing pearl, mother-of-pearl, and sponge fisheries in the Bay of Assab While funds are being raised for more extensive operations, this expedition is sent out to make a careful survey of the region, to form a depôt for further expeditions, whether commercial or scientific, and to make other preparations The expense is expected not to exceed 600*l* It is also stated that the Italian Geographical Society have made arrangements for the establishment of a meteorological station at the Bay of Assab The October part of the *Bolletino* of the Italian Geographical Society contains a long and valuable memoir by Signor C. de Amezaga on Assab.

AT the last meeting of the Lyons Geographical Society M. Coillard gave an interesting account of his twenty years' experiences in South Africa. He was engaged for some time on a missionary expedition in the Upper Zambesi region, and was probably the means of saving Major Serpa Pinto's life, afterwards accompanying him in some of his explorations. As no particulars have yet been published of M. Coillard's geographical work in this region, it is to be hoped that his paper will be given in full in the Lyons Society's *Bulletin*

IN last week's *Missions Catholiques* we have the concluding instalment of some interesting and useful papers by the Bishop of Vancouver, entitled "Une Visite Pastorale dans le Territoire d'Alaska." Père Montiton's notes on the traditions and customs of the Sandwich Islands are also continued.

THE January number of *Good Words* contains the first of a series of papers by Mr. Joseph Thomson on his experiences during his recent journey in East Central Africa. The present instalment deals with the preparatory journey which he made with Mr Keith Johnston to Usambara, and furnishes interesting notes on the country traversed.

THE Alexandria Correspondent of the *Daily News* tells us that M. Chower, formerly a newspaper correspondent in Turkey, Kurdistan, Armenia, and Albania, started on December 31, "to explore Africa from north to south, from Alexandria to the Cape of Good Hope." *Bon voyage*

THE death is announced of Dr. Fr. Mook, the well-known African traveller, who accompanied Dr. E. Riebeck on his expedition, which started in August last for the East. Dr. Mook died at Jaffa shortly before Christmas.

WE have received parts 17 to 22 of the new edition of Stieler's Hand-Atlas, with three supplementary parts containing in eight sheets a very fine map of the Basin of the Mediterranean Sea.

THE Dutch Committee, which arranged the North Polar Expeditions of the last few years, held a general meeting at the Hague a short time ago, when the resolution was passed to collect funds for the organisation of a fourth Arctic expedition In the meantime the Committee will endeavour to have a steamer built for this purpose.

ON HEAT CONDUCTION IN HIGHLY RAREFIED AIR [1]

THE transfer of heat across air of different densities has been examined by various experimentalists, the general result being that heat conduction is almost independent of pressure. Winkelmann (*Pogg Ann.* 1875, 76) measured the velocity of cooling of a thermometer in a vessel filled with the gas to be examined. The difficulty of these experiments lies in the circumstance that the cooling is caused not only by the conduction of the gas which surrounds the cooling body, but that also the currents of the gas and, above all, radiation play an important part Winkelmann eliminated the action of currents by altering the pressure of the gas between 760 and 1 millim. (with decreasing pressure the action of gas currents becomes less), and he obtained data for eliminating the action of radiation by varying the dimensions of the outer vessel He found that, whereas a lowering of the pressure from 760 to 91 4 millims there was a change of only 1 4 per cent. in the value for the velocity of cooling, on further diminution of the pressure to 4·7 millims there was a further decrease of 11 per cent, and this decrease continued when the pressure was further lowered to 1 92 millim.

About the same time Kundt and Warburg (*Pogg Ann.* 1874, 5) carried out similar experiments, increasing the exhaustion to much higher points, but without giving measurements of the pressure below 1 millim They inclosed a thermometer in a glass bulb connected with a mercury pump, and heated it to a higher temperature than the highest point at which observations were to be taken, then left it to itself, and noted the time it took to fall through a certain number of degrees. They found that between 10 millims and 1 millim the time of cooling from 60° to 20° was independent of the pressure, on the contrary, at 150 millims pressure the rate was one-and-a-half times as great as at 750 millims Many precautions were taken to secure accuracy, but no measurements of higher exhaustions being given the results lack quantitative value

It appears, therefore, that a thermometer cools slower in a so-called vacuum than in air of atmospheric pressure. In dense air convection currents have a considerable share in the action, but the law of cooling in vacua so high that we may neglect convection has not to my knowledge been determined Some years ago Prof. Stokes suggested to me to examine this point, but finding that Kundt and Warburg were working in the same direction it was not thought worth going over the same ground, and the experiments were only tried up to a certain point, and then set aside. The data which these experiments would have given are now required for the discussion of some results on the viscosity of gases, which I hope to lay before the Society in the course of a few weeks, I have therefore completed them so as to embody the results in the form of a short paper

An accurate thermometer with pretty open scale was inclosed in a $1\frac{1}{2}$ inch glass globe, the bulb of the thermometer being in the centre, and the stem being inclosed in the tube leading from the glass globe to the pump.

Experiments were tried in two ways:—

I The glass globe (at the various exhaustions) was immersed in nearly boiling water, and when the temperature was stationary it was taken out, wiped dry, and allowed to cool in the air, the number of seconds occupied for each sink of 5° being noted.

II. The globe was first brought to a uniform temperature in a vessel of water at 25°, and was then suddenly plunged into a large vessel of water at 65°. The bulk of hot water was such that the temperature remained sensibly the same during the continuance of each experiment. The number of seconds required for the thermometer to rise from 25° to 50° was registered as in the first case

[1] Abstract of a Paper read before the Royal Society by William Crookes, F R S, December 16, 1880.

It was found that the second form of experiment gave the most uniform results; the method by cooling being less accurate, owing to currents of air in the room, &c.

The results are embodied in the following Table:—

(Rate of Heating from 25° to 50°)

TABLE I

Pressure	Temperature	Seconds occupied in rising each 5°	Total number of seconds occupied
760 millims.	25°	0	0
	25 to 30	15	15
	30 to 35	18	33
	35 to 40	22	55
	40 to 45	27	82
	45 to 50	39	121
1 millim.	25°	0	0
	25 to 30	20	20
	30 to 35	23	43
	35 to 40	25	68
	40 to 45	34	102
	45 to 50	48	150
620 M.[1]	25°	0	0
	25 to 30	20	20
	30 to 35	23	43
	35 to 40	29	72
	40 to 45	37	109
	45 to 50	53	162
117 M	25°	0	0
	25 to 30	23	23
	30 to 35	23	46
	35 to 40	32	78
	40 to 45	44	122
	45 to 50	61	183
59 M	25°	0	0
	25 to 30	25	25
	30 to 35	30	55
	35 to 40	36	91
	40 to 45	45	136
	45 to 50	67	203
23 M.	25	0	0
	25 to 30	28	28
	30 to 35	33	61
	35 to 40	41	102
	40 to 45	55	157
	45 to 50	70	227
12 M.	25°	0	0
	25 to 30	30	30
	30 to 35	37	67
	35 to 40	41	108
	40 to 45	58	166
	45 to 50	86	252
5 M.	25°	0	0
	25 to 30	38	38
	30 to 35	43	81
	35 to 40	54	135
	40 to 45	71	206
	45 to 50	116	322
2 M.	25°	0	0
	25 to 30	41	41
	30 to 35	51	92
	35 to 40	65	157
	40 to 45	90	247
	45 to 50	165	412

There are two ways in which heat can get from the glass globe to the thermometer—(1) By radiation across the intervening space; (2) by communicating an increase of motion to the molecules of the gas, which carry it to the thermometer. It is quite conceivable that a considerable part, especially in the case of heat of low refrangibility, may be transferred by "carriage," as I will call it to distinguish it from convection which is different, and yet that we should not perceive much diminution of transference, and consequently much diminution of rate of rise with increased exhaustion, so long as we work with ordinary exhaustions up to 1 millim. or so. For if, on the one hand, there are fewer molecules impinging on the warm body (which is adverse to the carriage of heat), yet on the other the mean length of path between collisions is increased, so that the augmented motion is carried further. The number of steps by which the temperature passes from the warmer to the cooler body is diminished, and accordingly the value of each step is increased. Hence the increase in the difference of velocity before and after impact may make up for the diminution in the number of molecules impinging. It is therefore conceivable that it may not be till such high exhaustions are reached that the mean length of path between collisions becomes comparable with the diameter of the case, that further exhaustion produces a notable fall in the rate at which heat is conveyed from the case to the thermometer.

The above experiments show that there is a notable fall, a reduction of pressure from 5 M. to 2 M. producing twice as much fall in the rate as is obtained by the whole exhaustion from 760 millims. to 1 millim. We may legitimately infer that each additional diminution of a millionth would produce a still greater retardation of cooling, so that in such vacua as exist in planetary space the loss of heat—which in that case would only take place by radiation—would be exceedingly slow.

[1] M = millionth of an atmosphere.

SCIENTIFIC SERIALS

Journal de Physique, December, 1880.—Note on magic mirrors, by M. Bertin.—On some applications of articulated systems, by M. Robin.—Experiments on the discharge in rarefied gases, by M. Righi.—Notice on the life and works of M. Almeida.

Archives des Sciences Physiques et Naturelles, November 15.—Meteorological *résumé* of the year 1879 for Geneva and the Great St. Bernard, by M. Plantamour.—Disinfection of vehicles, plants, collections of natural history, and various objects with anhydrous sulphurous acid, by Dr. Fatio.—Observations on a memoir of M. Schönn, by M. Soret.—On the phenomenon of hydration in peptonisation of albuminoid substances, by Dr. Danilewsky.—Notes on the winds of mountains, by M. Pittier.—Case of diplopia, by Prof. Wartmann, &c.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti. vol. xiii. fasc. xviii., November, 1880.—This number contains lists of prizes awarded and offered.

Atti della R. Accademia dei Lincei, vol. v. fasc. 1 (December 5, 1880).—New studies on the nature of malaria, by SS. Cuboni and Marchiafava.—Graphic determination of the elastic force relative to plane elements passing through a point, by S. Modigliano.—On the geological nature of strata met with in the tubular foundations of the new iron bridge built on the Tiber at Ripatta, and on the *Unio sinuatus*, Lamk., there found, by S. Meli.—On the structure of the envelope of the ova of some fishes, by S. Leporì.—On the preservation of man in countries of malaria, by S. Tommasi Crudeli.—On bilinear ternary forms, by S. Battaglini.—On the projected stations for systematic physical observations in polar regions, by S. Cora.—On a cebocephalic capuchin monster, by S. de Sanctis.—On the recent restoration of the scholastic and tomistic philosophy, by S. Ferri.

SOCIETIES AND ACADEMIES

LONDON

Photographic Society, December 14, 1880.—J. Glaisher, F.R.S., president, in the chair.—Papers were read by Prof. T. E. Thorpe, F.R.S., on a simple and expeditious method of preparing pyrogallol for dry plate development. The method proposed is to put dry gallic acid and glycerine into a flask, which is then heated to 200° on a sand tray, as long as bubbles of carbon dioxide are seen to be formed in the liquid. The gallic acid soon dissolves and is entirely converted into the theoretical quantity of pyrogallol, viz., 80 per cent.—By Capt. Abney, R.E., F.R.S., iodide and ammonia in gelatine emulsions. It was stated that iodides in gelatine bromide emulsion kept the silver salts from being deposited upon the shadows, as also that there is freedom from decomposition of the film, and tendency to red fog, and more light can be used in preparing and developing the plates.—And also by Capt. Abney on a photographic sunshine recorder. This consisted of a semi-cylindrical box with a flat lid, in the centre of which is a small hole; round the inside of the cylinder strips of sensitive paper are

fixed; the instrument is then so placed that the sun, the hole, and the centre line of the paper are in the same plane, so that as the sun moves its track will be recorded on the paper.

Victoria (Philosophical) Institute, January 3.—A paper on the early destinies of man was read by Mr. J. E. Howard, F.R.S., F.L.S., &c., in which he considered them in relation to science, to philosophy, and also to religion, and gave an analysis of the various known traditions in regard to the early history of man in all ages and in all countries.

MANCHESTER

Literary and Philosophical Society, December 14, 1880.—E. W. Binney, F.R.S., F.G.S., president, in the chair.—Boulder stones as grave stones. The president, when visiting Ashton-under-Lyne the other day, observed in the churchyard on the Manchester Road a greenstone boulder used as a tombstone over the grave of a son of an alderman of that borough. This is the first instance where he had seen a boulder stone used for such a purpose, and it is one where they may not only be preserved, but exhibited to the public.—The land subsidence at Northwich, by Thomas Ward.—Some endeavours to ascertain the nature of the insoluble form of soda existing in the residue left on causticising sodium carbonate solutions with lime (Part ii.), by Watson Smith, F.C.S., Assistant Lecturer on Chemistry in the Owens College, and W. I. Liddle. Communicated by Prof. C. Schorlemmer, F.R.S.

PARIS

Academy of Sciences, December 27, 1880.—M. Edm. Becquerel in the chair.—M. Faye presented the *Annuaire du Bureau des Longitudes* for 1881, and noted the improvements.—On the series of Fourier and other analytical representations of functions of a real variable, by M. Hermite.—On the velocity of propagation of light, by M. Cornu. He controverts M. Gouy's ideas.—On the chlorhydrates of metallic chlorides, and on the reduction of chlorides by hydrogen, by M. Berthelot. These chlorhydrates play an important part in chemical mechanics, by reason of their considerable heat of formation and their state of dissociation.—On an oxygenated base derived from aldol, by M. Wurtz.—Effects of tearing out the intracranial part of the glosopharyngeal nerve, by M. Vulpian. This action does not (in the cat) appreciably affect the influence of nerves which act as direct vaso-dilators on the mucous membrane of the buccal cavity, except as regards the effects of excitation of the nerve itself on the posterior region of the dorsal face of the tongue.—Observations on some animals of Madagascar, by M. Milne-Edwards. This relates to an important collection of mammalia and birds by M. Humblot, sent to the Museum of Natural History. They show the modifications of species well. M. Humblot has sent to the menagerie two living Aye-Ayes, two Makis, &c. (offering many points of interest).—Order of production of the first vessels in the ear of *Lolium* (first part), by M. Trécul.—M. Sella was elected Correspondent in Mineralogy in room of the late Prof. Miller, and Mr. Warren De La Rue in Astronomy in room of the late Mr. MacLear.—Observations on phylloxera, by M. Lichtenstein. He indicates ten or eleven animal parasites of phylloxera, but does not regard any of these hopefully as a means of stopping the disease. He is studying the effect of inoculation with cryptogams; the results are not yet decisive.—Determination of the time of rotation of Jupiter, by M. Cruls. From observations of the spot at Rio Observatory during 1083 rotations he obtains the number 9h. 55m. 36s. in mean solar time. Mr. Pratt, at Brighton, got the number 9h. 55m. 33·91, from 321 rotations. Thus the time of Jupiter's rotation seems to be known to within a second.—On Hartwig's comet (*d* 1880), by MM. Schulhof and Bossert. They consider the period 6⅔ years must be rigorously excluded.—Solar observations at the Royal Observatory of the Roman College during the third quarter of 1880, by P. Tacchini. There was increased activity. The number of spots was double that in the preceding quarter, and there was hardly a day without them. The number of faculæ in September was extraordinary. In the case of the protuberances (also more frequent) there was a maximum in each hemisphere between 50° and 60° and another between 20° and 40°.—Observations on Swift's comet (*e* 1880) at the Royal Observatory of the Roman College, by P. Tacchini.—On the contact of conics and surfaces, by M. Moutard.—On a new method of producing intermittent luminous signals, by M. Crova. M. Leverrier and he used in 1870-71 a very similar arrangement to M. Mercadier's. They found that they must use oxygen under weak pressure and give the pipe a wide orifice; also that the key must be pressed and released very suddenly.—On a new electrodynamic theorem, by M. Cabanellas.—Regulator of pressure for vapours, by M. D'Arsonval. The triple problem here solved is (1) keeping constant, in a boiler, the pressure of a given vapour whatever the discharge; (2) using the combustible gas only in proportion to the vapour expended; (3) making the instrument quite automatic without danger of explosion. There is a membrane of caoutchouc between two metallic rings; its lower surface is in contact with the vapour, and on its upper rests a metallic disk with rod and lever like that of a safety valve. At the upper surface of the disk debouches a tube which brings the gas; there is another tube above through which the gas goes to the boiler.—On a new derivative of sulphide of nitrogen, by M. Demarçay.—On a platinous hypophosphite, by M. Engel. This is got by action of phosphuretted hydrogen on tetrachloride of platinum.—On borotungstates of sodium, by M. Klein.—On some facts relative to the transformation of chloral into metachloral, by M. Byasson.—On the products of oxidation of cholalic acid.—On the excretion by urine of sulphur incompletely oxidised, in various pathological states of the liver, by MM. Lépine and Flavard.—On visual sensibility and its relations with luminous and chromatic sensibility, by M. Charpentier. What he calls visual sensibility corresponds to visual acuteness, but while the latter is expressed by the smallest angle under which one can recognise as distinct two luminous points, the former is expressed by the smallest quantity of light which renders those two points distinct. The order of increasing complexity is, luminous sensibility, chromatic sensibility, visual sensibility.—On the distribution of light in the solar spectrum (spectrum of Daltonians), by MM. Macé and Nicati. These observations appear to give certain proof of the existence of two distinct kinds of Daltonians, also to support the Young-Helmholtz theory of colours, and to contradict Hering's.—Reactions of the motor-zone of the brain in animals paralysed by curare, by MM. Couty and De Lacerda.—On passage of red corpuscles into the lymphatic circulation, by M. Laulanie. This is effected by obliteration of veins. The effect appears in about twelve hours, and the number of corpuscles increases to about the fortieth hour.—On the internal and external sheaths of hairs, by M. Renaut.—New researches on the organs of touch, by M. Ranvier. By observing the tactile corpuscles in infants and children he has come to a better appreciation of their structure.—On the sensitive nerve-termination in the skin of some insects, by M. Viallanes. Examining larvæ of *Musca* and *Eristalis*, he finds under the hypodermis an extremely rich plexus of ganglionic cells, connected on one hand with the chief nerve-centres, and on the other with sensitive terminal nerve-branches.—On the sensorial cylinders of the internal antenna of crustaceans, by M. Jourdain. While these have undoubtedly the characters of an organ of sense, they cannot (anatomically, and independently of all physiological experiment) be said to be affected with olfaction.—Marine molluscs living on the coasts of Campbell's Island, by M. Filhol.—Examination of the marine fauna of the upper sands of Pierrefitte near Etampes, by M. Meunier.—On the age of upheaval of the district of Bray, by M. Dollfus.—On the crystalline schists of Brazil and the red earths which cover them, by M. Gorceix.

CONTENTS

THURSDAY, JANUARY 13, 1881

BAROMETRIC CYCLES

ABOUT twelve years ago Mr Baxendell of Manchester gave evidence of a connection between the convection-currents of the earth and the state of the sun's surface, and the subject has since been much discussed by meteorologists from various points of view.

Amongst these Mr Meldrum of the Mauritius Observatory has brought forward much evidence in favour of a connection between sun-spots on the one hand and rainfall and cyclones on the other. Still more recently the Indian meteorologists, including the names of Messrs Archibald, Blanford, Broun, Charles and Frederick Chambers, Eliot, and Hill have studied with much success the abnormal variations of barometric pressure in the tropics. Of these the researches of Mr F. Chambers are particularly interesting[1] as exhibiting a very close relation between such barometric fluctuations and the state of the sun's surface.

The chief principle underlying these investigations is sufficiently obvious. We know that the marked differences in barometric pressure which exist between various portions of the earth's surface must be due to the sun, if therefore the sun be in reality variable we should naturally expect these differences to vary likewise in such a way as to be strengthened when the sun is most powerful and weakened when he has least influence. In accordance with this way of regarding things, Mr. Chambers in 1876 pointed out that the abnormal variations of the monthly mean barometric pressure at Bombay in that year were mainly variations in the intensity of the usual seasonal movements, while in 1877 he attributed the uniformly high barometric pressure and the deficient rainfall of that year to a weak development of the equatorial belt of minimum pressure, probably induced by a diminution of the solar heat.

In a diagram attached to his first communication Mr Chambers compares the curve of solar-spotted area with other curves denoting the barometric pressure at various widely-distributed tropical stations, from which we can clearly see that there is a very marked resemblance between the salient points of the various curves on the hypothesis that a large amount of sun-spots corresponds to a low barometer. But besides this it appears that the epochs of maximum and minimum barometric pressure lag considerably behind the corresponding epochs of minimum and maximum solar-spotted area, and that this lagging behind is greater for easterly than for westerly stations, or in other words the abnormal barometric variations in the tropics may be said to travel at a very slow rate round the earth from west to east.

Perhaps the subject of greatest practical importance in these communications is the discussion regarding Indian famines and their connection with sun-spot minima—a connection first brought to light by Dr. Hunter. Mr Chambers sums up his conclusions on this point as follows:—

1. Variations of the solar-spotted area are succeeded months afterwards by corresponding abnormal barometric variations, a high barometer corresponding to a minimum of sun-spots.

2. Famines follow in the wake of curves of high barometric pressure.

Finally two methods are indicated by which early intimation of the approach of those meteorological disturbances which are attended by famines may possibly be obtained.

1. By regular observation of the solar-spotted area, and early reduction of the observations, so as to obtain early information of current changes going on in the sun.

2. By barometric observations at stations differing widely in longitude and the early communication of the results of stations situated to the westward.

While it thus appears that the evidence in favour of a connection between the state of the sun's surface and the meteorology of the earth is continually accumulating it may not be amiss to review briefly the present position of the problem.

In the first place Mr Meldrum, as already mentioned, has given evidence that in numerous stations the rainfall is greater about times of maximum than about times of minimum sun-spot frequency.

Secondly. Through his labours and those of M. Poey we have reason to believe that there are more cyclones in the Indian Ocean and hurricanes near the West Indies during times of maximum than during times of minimum sun-spot frequency.

Thirdly. There is the connection between the barometric fluctuations of the tropics and the state of the sun's surface which has just been pointed out.

Fourthly. From investigations in which I have been recently engaged there is reason to suppose that sun-spot inequalities of short duration are followed by corresponding inequalities in the diurnal temperature range of Toronto in such a way that a large amount of sun-spots slightly precedes a large temperature range.

Fifthly. To go from meteorology to magnetism there is the well known connection first observed by Sabine, in virtue of which the diurnal oscillations of the magnet are greatest about times of maximum sun-spots. And I may add that magnetic maxima lag behind sun-spot maxima, while there are also indications that magnetic weather, like meteorological weather, travels from west to east.

We thus perceive how strong the evidence is in favour of some connection between the state of the sun's surface and terrestrial meteorology, while at the same time it is unmistakably indicated by all elements that this connection is of such a nature as to imply that the sun is most powerful when there are most spots on his surface. Add to this that the spectroscopic observations of Lockyer and others tend in the same direction, as well as such actinometric results as we have been able to procure, chiefly through the labours of Mr J. H. Hennessey at Dehra Dhoon and Mussoorie.

In fine this hypothesis is rapidly emerging, if indeed it has not already emerged, from the regions of mere conjecture.

But here it is necessary to bear in mind the following considerations. Prof. Stokes has pointed out that the problem before us really involves two questions, which may be stated as follows:—Firstly, do the changes which take place in the sun's surface correspond to changes in

[1] See NATURE, November 25 and December 2, 1880.

the meteorology and magnetism of the earth, and if so, does an increase of spotted area denote an increase of solar activity, or the reverse?

This question, I have already remarked, seems to be rapidly emerging from the realms of mere conjecture But there is still another question, for we have to inquire whether these recognised solar inequalities bear all or any of the marks of a true periodicity Now this is still *sub judice*, while at the same time it is a point of very great practical importance. For if the solar inequalities be found on investigation to present none of the marks of a true periodicity, we can hardly hope ever to be able to hazard a prediction regarding the state of the sun, and our knowledge of the eleven-yearly period, as it is called, will continue to remain very much the same as at present But on the other hand, if we find that there are true solar periods and succeed in disentangling them, we may hope to arrive at some measure of predicting power As I have said, this question is still unsettled, and will of course present itself in different ways to different observers Meanwhile all we can do is to observe and register the actual state of the sun's surface, and inasmuch as the meteorological occurrences of greatest practical issue do not precede but follow solar phenomena by several months or more, we may thus arrive at a limited amount of practical prevision.

I do not however feel sure that the method of doing this which Mr Chambers has indicated is in reality the best, for I should imagine that unexceptionable observations of the sun's intrinsic heat-giving power, if these could be obtained, would furnish a more trustworthy instrument of prevision than the sun-spot record.

Then with regard to indirect observations No doubt those of the barometer are very immediately connected with the occurrences which we wish to foresee, but yet I think it possible that well-selected magnetic observations might ultimately be found to follow more quickly upon solar changes as well as to indicate with a less amount of local influence the true state of the sun

These however are points that can only be settled by future research Meanwhile it is extremely gratifying to all who take an interest in this subject to reflect that it is engrossing the attention of observers in all parts of the world.

BALFOUR STEWART

LIFE OF LIVINGSTONE

The Personal Life of David Livingstone, LL.D., D.C.L Chiefly from his Unpublished Journals and Correspondence in the Possession of his Family. By William Garden Blaikie, D D., LL.D, New College, Edinburgh. Portrait and Map. (London. Murray, 1880)

WHEN the news of Livingstone's sad death on the swampy shore of Lake Bangweolo reached this country, and when his body was brought home by his faithful followers to be honoured as the nation honours its greatest and best; and again on the publication of his "Last Journals," we spoke in some detail of the great work he accomplished, and expressed our opinion as to the position which that work had earned for him. The years that have elapsed since Livingstone died at his post have only confirmed the judgment of the nation; and now that Dr. Blaikie's admirably-compiled "Personal Life" enables us to fill up the portrait, it will be seen that the man was as great as his work. Necessarily the missionary and religious side of Livingstone's character and work occupies a large place in this volume; this was to be expected from a writer who is a prominent leader in the Free Church of Scotland. But we do not think there is any excess in this direction, these were genuine and ever-present aspects of the character of the man, and Dr Blaikie does not give them place at the expense of any other feature He has honestly endeavoured to give us a complete portrait of his hero, and in this we think he has decidedly succeeded Simplicity and transparency were marked features in Livingstone's character from first to last; delight in simple joys, a boyish love of fun, tenderness of heart and all-embracing charity, strong natural affection, the yearnings of which he could and did sacrifice to his still stronger sense of duty, the whole dominated by an all-conquering determination and perseverance in accomplishing the work which he believed was "given him to do" This is the impression which Dr Blaikie's "Personal Life" gives, and in this it only confirms the impression which is conveyed by a study of Livingstone's own narratives

Dr Blaikie, however, tells us many things which must be new to most of those who knew Livingstone only through his works We learn here how well qualified he was for the work which from early years he seems to have set before himself Livingstone came of a good stock, which, though humble, knew of and had some pride in its ancestry One ancestor fought at Culloden on the side of Prince Charlie, for on the mother's side he had some Highland blood in his veins But the impulsive and sad temperament of the Celt was considerably modified by the practical and hopeful features of the Teutonic blood of his father. The latter was a type of the devout, rigidly honest, intelligent, and comparatively well-read, humble Scotchman, while the mother held the love and respect of her son to the end of her life. The family were poor, and all had to work hard, and early in life young Livingstone had to begin to earn his living in a cotton-mill at Blantyre, near Glasgow, where he was born March 19, 1813 With his first wages he bought a copy of Ruddiman's "Latin Rudiments," and thus early, it is evident, his aspirations went beyond the cotton-mill. His hours were long, but while attending to his "jenny," and till late at night, after his day's work was over, he conned his Ruddiman and other books to qualify himself for a University course His thirst for reading was great, and he devoured all the books that came within his reach Natural science also had its attractions for him, which he indulged by scouring the country when he had time in search of natural history specimens. Dr. Blaikie tells of Livingstone's "conversion" when he was a young man. This, in his case, means that what was instinctive action became thenceforth settled and conscious purpose It was doubtless a proud day both for father and son when the former walked with the latter to Glasgow to see him settled in a humble lodging in order that he might attend the classes at Anderson's College. Livingstone never intended to be a clerical missionary; medicine was the subject of his study in Glasgow, and it was as a medical missionary he intended to accomplish the work of his life. It was only to please his friends and the

London Missionary Society he consented to "ordination" Chemistry seems to have been a favourite subject with him at college, and Dr Blaikie narrates an interesting incident in which Livingstone and James and William (now Sir William) Thomson and Lyon Playfair met together at James Young's (now of Kelly) rooms, to witness some chemical experiment Having been accepted by the London Missionary Society, Livingstone went to London to complete his medical studies, get some lessons in theology, and learn to preach His failure in the latter accomplishment nearly led to his final rejection, and no doubt determined the Society to send him to the rough and humble field of Africa, instead of to China, on which his heart was set The decision must be regarded as in every respect fortunate, though Livingstone had been some time in Africa ere he got over his disappointment. He went out to his work in Africa in 1841, and how anxious he was in every way to qualify himself for that work is shown by the fact that he got the captain of the ship in which he sailed to teach him the use of the quadrant and how to take lunars With a few more lessons in taking observations from Sir Thomas Maclear at the Cape, he became an adept in this kind of work, and Sir Thomas afterwards expressed his astonishment at the almost perfect accuracy of Livingstone's observations in this department He left the Cape as soon as he could and made for Moffat's station at Kuruman Still further north he went, about 250 miles, and settled for some time among the Bechuanas, over whom, as over all other natives with whom he came into contact, he soon acquired great power and influence His idea of a missionary's work was very practical, and rapidly developed and expanded, after he set foot in Africa From the first he gave attention to geography, and his early letters are full of geographical details, illustrated by little sketch maps How early his mind was attracted by the scientific questions connected with the geography of Africa will be seen from the following passage from the work before us —

"The progress of medical and scientific work during this period is noted in a letter to Dr Risdon Bennett, dated 30th June, 1843 In addition to full details of the missionary work, this letter enters largely into the state of disease in South Africa, and records some interesting cases, medical and surgical Still more interesting, perhaps, is the evidence it affords of the place in Livingstone's attention which began to be occupied by three great subjects of which we shall hear much anon - Fever, Tsetse, and 'the Lake' Fever he considered the greatest barrier to the evangelisation of Africa Tsetse, an insect like a common fly, destroyed horses and oxen, so that many traders lost literally every ox in their team As for the Lake, it lay somewhat beyond the outskirts of his new district, and was reported terrible for fever He heard that Mr. Moffat intended to visit it, but he was somewhat alarmed lest his friend should suffer It was not Moffat but Livingstone, however, that first braved the risks of that fever swamp.

"A subject of special scientific interest to the missionary during this period was—the desiccation of Africa On this topic he addressed a long letter to Dr. Buckland in 1843, of which, considerably to his regret, no public notice appears to have been taken, and perhaps the letter never reached him. The substance of this paper may, however, be gathered from a communication subsequently made to the Royal Geographical Society (see *Journal*, vol. xxvii. p. 356) after his first impression had been confirmed by enlarged observation and discovery Around and north of Kuruman, he had found many indications of a much larger supply of water in a former age He ascribed the desiccation to the gradual elevation of the western part of the country. He found traces of a very large ancient river which flowed nearly north and south to a large lake, including the bed of the present Orange River; in fact he believed that the whole country south of Lake 'Ngami presented in ancient times very much the same appearance as the basin north of that lake does now, and that the southern lake disappeared when a fissure was made in the ridge through which the Orange River now proceeds to the sea He could even indicate the spot where the river and the lake met, for some hills there had caused an eddy in which was found a mound of calcareous tufa and travertine, full of fossil bones. These fossils he was most eager to examine, in order to determine the time of the change, but on his first visit he had no time, and when he returned he was suddenly called away to visit a missionary's child, a hundred miles off It happened that he was never in the same locality again, and had therefore no opportunity to complete his investigation"

It was not likely that a man whose mind was filled with such problems would be content to settle down to the dull routine of the work of a common missionary, and count his success by the tale of doubtful "conversions" he could send home to his constituents He kept moving onward from one station to another, getting further and further into the interior, gaining the love of the natives and the hatred of the Boers By his example more than by direct teaching he showed the people the beauty of right living, and taught them many industrial arts which some of them have not lost till this day But his longing was ever northwards, and his eager desire to solve the mystery of Lake 'Ngami It was not till 1849 however that he was able to visit the lake, and his account of the visit first brought him permanently into notice as a working geographer This may be said to have ended the first stage of Livingstone's career, that in which the missionary was predominant It seems to us, however, doubtful whether Livingstone ever intended definitely to settle down to the life of a missionary Even from the beginning, we think, he must have had some vague idea of combining the function of missionary and explorer, always, however, with the one great object in view of bringing Africa under the influences of civilisation and Christianity Shortly after the 'Ngami excursion he became a missionary at large Returning to Cape Town, he sent home his wife and children, and prepared himself for the great work of exploring the Zambesi Proceeding northwards to Linyanti in 1852, he set out on that ever memorable journey to Loanda and across the continent to Quilimane, which stamped him as one of the greatest explorers of all time The story of this and of his subsequent work in the region of Lake Nyassa, and of his many years' wandering all over Central Africa, he has told himself, and Dr Blaikie wisely refrains from introducing more of it than is really necessary to hold together the narrative of his Personal Life. All that Livingstone has done for Africa it is not easy to estimate. It is he more than any other explorer who has filled up the great white blank in the maps of our schoolboy days. His geographical instinct was surer than that of any other man, only once was it seemingly at fault, when he wandered away by Lake

Bangweolo seeking for the "fountains of the Nile", and that one mistake cost him his life Men like Sir Thomas Maclear, Prof Owen, and Sir Roderick Murchison testify to the high value of his observations in various departments of science, and it is due to his example and initiative that Africa is now covered with an army of explorers. Livingstone was a man who was consumed with a definite and noble purpose, which he firmly believed it was his duty to carry out unto death In doing so he was bound to give offence, and he did make enemies, and so must every man who is able to conceive a great purpose and possesses strength of will and energy of physique sufficient to carry it out. Had he been weakling enough to be swayed by the scruples of others he would never have left Cape Town No great work was ever yet accomplished without sacrifice, and we have here mainly to do with the work which Livingstone accomplished for science. That work is the highest of its kind, and had Livingstone been either a Byron or a Napoleon in character, the value of that work would not have been less. Fortunately it is clear from Dr Blaikie's pages—which consist largely of Livingstone's own journals and letters—what indeed was pretty clear before, that Livingstone was a pure and tender-hearted man, full of humanity and sympathy, simple-minded as a child, with a healthy ambition to do a great work for Africa and for science, and with energy and courage sufficient to carry it out The motto of his life was the advice he gave to some children he addressed in a humble Scotch meeting-house when he returned from his first great journey and found himself a great man—"Fear God and work hard"

SALVADORI'S ORNITHOLOGY OF NEW GUINEA

Ornitologia della Papuasia e delle Molucche di Tommaso Salvadori Parte prima 1 vol 4to 540 pp (Torino, 1880)

IN the second volume of the Linnean Society's *Journal of Proceedings*, published in 1858, will be found an article by Mr Sclater on the Birds of New Guinea, which gives in a few pages a summary of the then existing state of our acquaintance with this subject. The bulky quarto now before us, to be followed by three or four other similar volumes, is no bad evidence of the vast mass of additions that has been made to our knowledge of the Papuan avifauna since that period

In 1857 the only modern authorities on the birds of New Guinea were the naturalists of the French circumnavigating expeditions, who had explored the vicinity of Havre Dorey in the northern peninsula of the island, and the collectors for the Leyden Museum, who had visited Lobo Bay and other points on the south coast. Although much is still wanting to complete our knowledge of the Papuan avifauna, much has been done since those days In 1858 our famous countryman Mr. Wallace passed some months at Havre Dorey, and made excellent collections in every branch of zoology. Moreover in the neighbouring island of Batchian Mr. Wallace was fortunate enough to come across a new form of paradise bird—one of the few recent additions to this remarkable group—which was deservedly named after its discoverer, *Semioptera wallacii*. Mr Wallace was also the first of modern explorers to visit the Arroo Islands—which belong strictly to the same fauna as New Guinea, and in his well-known work on his "Travels in the Malay Archipelago" has given us a most interesting account of the habits of the paradise birds as there observed, and of the manner in which the natives procure their specimens

After Mr Wallace the Italian travellers D'Albertis and Beccari were the next to visit New Guinea, and succeeded in carrying their investigations further into the unknown interior than it had been hitherto believed possible to penetrate. The ascent of the Arfak Mountains was first accomplished by D'Albertis in 1872, and Beccari succeeded in making the same dangerous journey some years later, besides visiting many localities on the north coast which had not been previously explored Both these naturalists were active collectors of birds, and transmitted large collections to Europe. In 1875 and the following year D'Albertis turned his attention to the southern portion of New Guinea, and during his excursions up the Fly River made fresh additions to our knowledge of Papuan ornithology In the meantime a German naturalist, Dr A B. Meyer of Dresden, was engaged on new explorations on the shores of the great Bay of Geelvinck, and did not fail to make considerable additions to the rich avifauna of that district.

While Prof Salvadori has not neglected to consult every existing authority on Papuan ornithology, and, we believe, to visit every European museum which contains specimens from the Papuan region, it is mainly upon the large series accumulated by his countrymen D'Albertis and Beccari, to which must be added the numerous specimens obtained by the hunters of Heer A A. Bruijn of Ternate, that his present labour is based These collections, or at any rate all the important portions of them, have passed into the Museo Civico of Genoa, either through the liberality of the Marquis G Doria, the founder of that institution, or through assistance given by the Italian Government Their extent may be judged of from the fact, stated in the preface to the present volume, that they contained no less than 9539 specimens, which have thus come directly under Prof. Salvadori's observation, besides the examples examined in the Museums of Paris, London, Leyden, Bremen, Berlin, Dresden, and Vienna, which, as already stated, our author has visited for the purpose of preparing his work It is evident therefore that materials did not lack, and Prof. Salvadori's well-known abilities as an ornithologist give us every confidence that these materials will have been well used.

Such indeed is doubtless the fact If the succeeding volumes of the "Ornitologia della Papuasia" shall be executed in the same style as that in which the first volume has been prepared, there can be no question that a most important work will have been accomplished. Not only is every species fully and accurately described, but its complete synonymy is given, a detailed list of the specimens from various localities and remarks on their differences are added, and, in fine, every necessary particular is given that can contribute to a perfect history of the species. Would that other geographical works on ornithology were carried out with equal exactness and similar strict attention to details!

In conclusion we have only to express our thanks to

Prof. Salvadori for the admirable way in which he has commenced his laborious task, and to express our hope that he may bring it to a successful conclusion. In Mr Gould's great work on the "Birds of New Guinea" we have a series of magnificent illustrations of all the more remarkable forms of Papuan ornithology. Such a work as that of Prof Salvadori's was much wanted in order to perfect our knowledge of the history and literature of this attractive subject.

OUR BOOK SHELF

An Elementary Treatise on the Integral Calculus, containing Applications to Plane Curves and Surfaces, with numerous Examples. By B Williamson, F R S. (London Longmans, 1880)

OF a *third* edition we need only remark that it is a carefully revised issue of the second, and point out the few important additions that have been made In the discussion of Frullani's theorem (§ 119), a simple shape of the formulæ, due to Mr E. B Elliott, is given, and reference made to other articles on multiple definite integrals by the same gentleman (and by Mr Leudesdorf) in the *Educational Times* (1875) and in the *Proceedings* of the London Mathematical Society, 1876-7 A new article (119*a*) gives a proof of a simple character, by Zolotareff, of the remainder in Lagrange's series § 147 contains a remarkable extension of Holditch's theorem, due to Mr Elliott (*Mess of Math* February, 1878), and § 147*a* gives the "singularly elegant" theorem discussed by Mr. Kempe (*Mess. of Math* July, 1878), to which reference is made in Prof Minchin's letter in NATURE (December 23, 1880), in which he proves these theorems from other considerations. Various insertions of a minor character increase the volume by more than twenty pages A good feature of the present edition is an index at the end of the work

Botanisches Centralblatt Herausgegeben von Dr O Uhlworm Band 1, Quart. 1 4 (Cassel Fischer, 1880)

WE are now able to record the completion of the first volume of this valuable serial, a monument of extraordinary energy on the part of the editor and his band of assistant. The aim of the publication is to give an abstract or *résumé* of every important contribution to botanical science published in the scientific serials of the Continent of Europe, Great Britain, and America, and, as far as we have been able to judge, the undertaking has been carried out with great judgment and completeness Original works are also not neglected Appearing much more promptly than Just's "Jahrbucher," the "Centralblatt" is indispensable to any one who desires to keep abreast of any department of botanical science.

Botany for Children, an Illustrated Elementary Text-Book for Junior Classes and Young Children By the Rev. George Henslow, M A, F L S, &c (London, Edward Stanford, 1880)

WE do not think that botany can be taught with advantage to children from books. No method of teaching seems so well adapted to the wants of junior students as that of demonstration A flower pulled to pieces by the student and the parts and their importance intelligently explained by the teacher forms a lesson far more valuable than any to be got from a text-book With a few such demonstrations from easily-obtained flowers, taken as they present themselves, most of the elementary facts regarding flowering plants can be readily mastered, while the habits of observation and the facility of dissecting thus obtained are invaluable to the student. It is, we fear, too much the habit in teaching botany to make the student prepare a lesson from the text-book as if it were spelling or history This is really what should be most carefully avoided, although there must be a great temptation to proceed with the book lesson when the plant is not obtainable Mr Henslow states in his preface "The descriptions of flowers in this book are intended to form botanical reading-lessons, specimens of the flowers being at the same time placed in the hands of the pupils, who are required to dissect and examine them carefully, and be sure they see and understand each special part noticed in the text" When used in accordance with the directions laid down by the author, the book seems an excellent one, and calculated to serve its purpose well, although some very important types have been omitted for want of space. As we have known children to work out the structure of flowers for themselves by means of this little book and to enjoy the exercise, we believe the work will be deservedly popular The illustrations are rather coarse, but on the whole characteristic and often give details of structure sometimes omitted from much larger works

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts No notice is taken of anonymous communications*

The Editor urgently requests correspondents to keep their letters as short as possible The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Geological Climates

I NOW proceed to justify my statement, which has caused Mr Wallace great surprise, viz —

"It is impossible to suggest any rearrangement of land and water which shall sensibly raise the temperature of the west of Europe, or sensibly depress the temperature of the east of North America"

It is proverbially difficult to prove a negative, and the only way to do so in this case is to show that any given redistribution of land and water is incapable of producing the effects ascribed to it

I have already shown that Mr. Gardner's proposed redistribution by means of a land connection between Greenland and Europe would fail to benefit the west of Europe In like manner I shall now demonstrate that Mr. Wallace's redistribution of land and water is quite inadequate to raise the temperature of the west of Europe.

Mr. Wallace's proposal is to introduce two new Gulf Streams into the Arctic Ocean, in addition to the present Gulf Stream

1 The first of these additional Gulf Streams would be the Kuro siwo, admitted through a widened Behring's Strait, the effect of which, he estimates, would be *to prevent altogether the formation of ice in the Arctic Sea*

2. The second additional Gulf Stream is provided by allowing the waters of the Bay of Bengal and of the Arabian Sea an outlet to the north through the Caspian depression into the Arctic Ocean The effect of this second Gulf Stream, he estimates, would be *to raise the temperature of the Polar ocean from 15° F to 20° F above the freezing point of water*

This mode of raising the temperature of the Arctic regions, so as to allow of the growth of their Miocene flora, occurred to me when speculating on the former high temperatures of these latitudes, but I rejected it as inadequate to account for the change of climate required for the following reasons But before giving these reasons I wish to add that Mr. Wallace has given two precise statements involving quantitative results, without giving the numerical grounds on which he made those statements.

The following are the grounds on which I deny the adequacy of Mr. Wallace's causes of change of climate —

(*a*) *Air and Water.*—Warm winds and cold winds are in themselves of little consequence in influencing climate, except they blow over a large expanse of warm or cold water, they are in fact only heat and cold carriers for the water. The specific heat of water is more than four times that of air, and water is 815 times heavier, bulk for bulk; therefore one cubic mile of water will contain as much heat as 3260 cubic miles of air at the same

temperature. From this it follows that the temperature of the air at the surface of the sea corresponds with the surface-temperature of the water. This has been fully confirmed by observations made in every latitude, which show that the difference of temperature between the air and sea is never more than one or two degrees Fahrenheit.

(*b*) *Gulf Stream.*—The temperature of the air above the Gulf Stream is:—

62° F.	at latitude 40°	45° F.	at latitude 60°
53 „	„ 50°	35 „	„ 70°

and the quantities of water contained in the Gulf Stream are:—

36 cubic miles per hour	at latitude 50°
36 „ „	„ 60°
24 „ „	„ 70°

The mean annual temperatures of the several latitudes, in the northern hemisphere, are, taken all round the globe—

29·3° F.	at latitude 60°	4·5° F.	at latitude 80°
14·4 „	„ 70°	0·0 „	„ 90°

From this it is evident that the Gulf Stream is inadequate to keep the temperature of the Polar cap, from the Pole to 60° lat., above the freezing point of water; so that if the heat and cold were uniformly distributed, the whole of this great area would be permanently frozen over, the thickness of the ice being greatest at the Pole, and least at lat. 60°.

This ideal ice cap (on the supposition of uniformly distributed heat and cold) represents accurately the amount of heat that must be introduced into the Arctic regions before their temperature rises to that of the freezing point of water. Its southern limit is lat. 58° 51′, where the mean annual temperature all round the globe is 32° F.

The thickness of this ideal ice cap at the Pole is unknown, but from what we know of the palæocrystic ice of Bank's Land and Grinnel Land must be measured by hundreds of feet; and its mean temperature must be at least 20° F. below the freezing point of water.

Mr. Wallace has put forward the supposition that the introduction of an equal proportion of the Kuro-siwo (to that of the Gulf Stream) would prevent the formation of sea-ice in the Arctic Sea. Before this could happen, the Kuro-siwo must first melt the ice-cap, and then keep it from freezing again.

To show how inadequate this supposition is, I shall calculate what the Gulf Stream has already done, and then show what the Kuro-siwo could do.

Let us suppose that the whole heat of the Gulf Stream, passing northwards through the parallel of 70° N., is employed in melting a supplementary ice-cap extending from the Pole to 70° N. and that this supplementary ice-cap is at the temperature of 32° F. only (*mere ice-sludge*); I find the thickness of ice melted is only 5·874 feet[1] yearly.

If therefore the Gulf Stream were cut off by a barrier at 70° N. lat. an additional growth of ice at 32° F. less than 6 feet thick might grow upon the area from the Pole to 70° N. lat.

Of course the Gulf Stream expends its heat in melting local ice in the Spitzbergen and Barentz Seas, and perhaps still further east in summer along the Siberian coast, and not in melting the supplemental ice-cap I have imagined; nevertheless the whole work done by it does not exceed the melting of the ice cap from the Pole to 70° lat., and of a uniform thickness of 5·874 feet. In other words, the work done by the Gulf Stream north of 70° lat. is equivalent to the melting of 4382 cubic miles of ice at 32° F., which represents a definite quantity of heat. It is however much easier to conceive the ice-cap from the Pole to 70° lat., of 5·874 feet thick, than 4382 cubic miles of ice.

As the ice melted between the Pole and 70° lat. has a temperature of 6° F., instead of 32° F., it is easy to see that the thickness of ice-cap melted by the Gulf Stream is 4·813 feet instead of 5·874 feet.

(*c*) *The Kuro-siwo admitted through Behring's Strait.*—Mr. Wallace quotes me as stating that the volume of the Kuro-siwo is 2½ times the volume of the Gulf Stream: I believe it to be so, but in the present discussion shall consider it to be only twice as great; for at least one-fifth of it obtains partial entrance into Behring's Strait, and behaves like the Gulf Stream; as appears from the lesser rigour of the climate of the Parry Islands, from the open water discovered by Collinson along the northern coast of America, and from the return cold current of the coast of China.

From the calculations I have just given it appears that the Kuro-siwo current admitted through a widened Behring's Strait would be competent to melt a thickness of ice-cap extending from the Pole to 70° lat., amounting to 9·626 feet.

I shall leave your readers to judge whether this amount of ice melting justifies Mr. Wallace in asking "Suppose that only an equal proportion (to that of the Gulf Stream) of the Kuro-siwo entered the Arctic Ocean, is it not probable that no sea-ice at all would form there?"

To me this question appears like a proposal to Hercules to clean out the Augean stables with a teaspoon.

(*d*) Let us now add on the *Mozambique Current*, converted into a *Caspian depression Gulf Stream*. Of this current I cannot allow Mr. Wallace to appropriate more than half, unless he shows cause for a land barrier preventing the other half from continuing its present course into the southern hemisphere, there to aid in mitigating the climates of the Temperate and Antarctic zones.

The *Caspian Gulf Stream* will then cut off another slice of 3·609 feet in thickness from the ice-cap extending to 70° lat. Is this amount of ice melting sufficient to perform the feat assigned to it by Mr. Wallace of "raising the former [the Polar sea] to perhaps 15° or 20° F. above the freezing point"?

(*e*) If there be any truth at all in the power of Gulf Streams to modify the climates of the Temperate and Polar zones, the southern hemisphere should be warmer than the northern hemisphere, as it receives three Gulf Streams instead of 1½ Gulf Streams (without discussing their relative volumes).

This is the actual fact, as is easily proved, notwithstanding the iterated parrot-like statements to the contrary copied from text-book to text book.

I have shown that, taking the annual mean temperature at all longitudes, the cold of the northern hemisphere is represented by an ideal ice-cap which is thickest at the north pole and terminates in the latitude 58° 51′ N., where the mean annual temperature is 32° F.

In the southern hemisphere, the latitude at which the mean annual temperature for all longitudes is 32° F., is found at 62° 41′ S. This limit of the ideal southern ice-cap (measuring the Antarctic amount of cold) lies nearer to the South Pole by 3° 50′, or 230 geographical miles, than the corresponding limit of the northern ice-cap from the North Pole.

These limits of ideal ice-cap at the North and South Poles are independent of the wholly different question as to which of the Poles has the largest volume of ice surrounding it, into which I shall not enter at present.

(*f*) From what I have proved above it is evident that the two return compensating currents from the Arctic seas will still consist of ice-cold water, one of which, on the coast of Asia, of double the volume of the Labrador current, will reduce the climate of China and Northern Japan to a condition compared with which the present climate of Hudson's Bay would be a Garden of Eden; and the other would bring the Ural range and Eastern Europe into the present condition of Labrador. I think it is evident, under these latter conditions, that Bournemouth would suffer, and not gain, by Mr. Wallace's arrangements of land and water. The services rendered to the Arctic lands by the two new Gulf Streams would, in my opinion, be dearly purchased by the damage done by their compensating currents in the sub-tropical latitudes of Eastern Asia and Eastern Europe.

SAML. HAUGHTON

Trinity College, Dublin, December 31, 1880

IN NATURE, vol. xxiii. p. 169, Mr. Ingram mentions the growth of *Bambusa metaké* in Leicestershire. I have found large varieties of bamboo cultivated on a great scale in Northern Nippon, where the winter temperature is certainly much colder than in England. The northernmost place where I found them was the vicinity of Yokobori, about 39° 12′ N., at a small distance (twenty-five miles) from the west coast. The nearest place to the south where observations were made is Niigata, 37° 55′, and to the north Hakodate, 41° 46′. The coldest month has a temperature respectively of 33°·0 and 27°·3 F. Yusawa being situated about 450 feet high, and in the interior, the coldest month there must have not over 30°, and a heavy snowfall is the rule every winter. Again, on descending the dividing ridge

[1] I assume the following data:—Area from Pole to 70° lat. = 4,476,200 sq. geo. m.; latent heat of ice cold water = 142° F.; Gulf Stream = 24 cub. miles per hour; temperature = 35°·6 F.

between Jukussina and Yonesawa, I first found large bamboo plantations near the last place, about 1000 feet above sea-level, and 37° 55′ N. Between here and Niigata the temperature of the coldest month must differ by about 3°, the latter place being situated near the sea. This gives about 30° F. for Yonesawa, or about the same as at Yusawa. Now in Great Britain, the mountainous districts excepted, the mean temperature of the coldest month is nowhere lower than 36°. A. WOEIKOF

St. Petersburg, December 19, 1880

IN my letter (vol. xxiii. p. 194) I inadvertently stated that Sequoia cones were composed of from 16 to 20 scales. I intended to say 16 to 50, which appears to be the maximum number in either of the existing species. J. S. G.

Chalk

THE objections urged by Mr. S. N. Carvalho, jun. (vol. xxiii. p. 194), to Wallace's explanation of the deposition of chalk must have occurred to every geological reader of "Island Life." There are very many other objections to it, and I trust to be permitted to call attention to them in the *Geological Magazine*, as they are probably too purely geological to interest the readers of NATURE.

J. S. G.

Average Height of Barometer in London

IT was stated in your "Meteorological Notes" a week or two ago in regard to the paper by Mr. H. S. Eaton on the average height of the barometer in London, that "the series is sufficiently extended as to entitle it to be considered one of the most valuable we possess in dealing with questions of secular meteorological variation."

Regarding it in the same light I have thought it worth while to apply Mr. Meldrum's method for discovering the existence and character of the secular variation in the sun-spot cycle. Taking the period 1811–79 I find the following figures for the mean cycles:—

LONDON

Annual Barometric Abnormals, Mean Cycles

	Maximum years in fifth line		Maximum years in seventh line	
	Pressure (1811–77)	Sun-spots (1811–77)	Pressure (1816–79)	Sun-spots (1816–72)
1.	+0·006	−33·9	−0·005	+23·3
2.	+ ·016	−23·4	− ·001	+14·5
3.	+ ·013	0·0	− ·001	+ 4·8
4.	− ·002	+28·2	− ·003	− 5·6
5.	− ·010	+43·1	− ·005	−19·0
6.	− ·011	+34·2	·001	−32·5
7.	− ·007	+16·8	± ·000	−37·1
8.	+ ·001	+ 0·2	+ ·011	−25·4
9.	± ·000	−14·2	+ ·021	+ 1·8
10.	+ ·001	−24·2	+ ·010	+30·9
11.	± ·000	−26·3	− ·003	+44·8

The variation of pressure, though not so regular as that I worked out for St. Petersburg in 1879, is of an almost exactly opposite character, the minimum pressure appearing as in India, about the time of maximum sun-spot, and the maximum pressure lagging two years behind the epoch of minimum sun-spot. These results agree with the known annual rainfall variation in the same cycle, which is likewise similar in character to that which occurs in the tropics. I would suggest that the marked difference between the results for London and St. Petersburg possibly arises from the close communication between England and the tropics through the medium of Atlantic oceanic and atmospheric currents. E. DOUGLAS ARCHIBALD

January 4

Experiments with Vacuum Tubes

IN my letter published in the last number of NATURE I omitted to say that we have compared vacuum tubes without electrodes with a tube containing water. A tube was filled about nine-tenths full of water and then sealed hermetically. It was then applied to the prime conductor of the electric machine and electrified in the same way as the vacuum tubes without electrodes, and it was found to behave precisely as they did. The water tube became charged as a double Leyden jar, positive outside and negative inside at the end next the prime conductor, and negative outside and positive inside at the other end. A great tendency to rupture of the glass was also observed. So far as we have been able to see the most perfect vacuum that I have been able to obtain with the Sprengel pump has behaved as to frictional electricity precisely as a perfect conductor such as water.

These experiments seem interesting in connection with the discoveries of Mr. Crookes as to the properties of a very perfect vacuum. No doubt it was known that flashes can be obtained within vacuum tubes without electrodes; but the properties of a perfect vacuum as a conductor of electricity has not been hitherto sufficiently investigated. J. T. BOTTOMLEY

Physical Laboratory, the University, Glasgow, January 8

Oxidation of Quinine, &c.

IN the Chemical Society's *Journal* for December, 1880, there is an abstract of a paper by Hoogewerf and Van Dorp, published in *Liebig's Annalen*, cciv. 84–118, in which the authors describe experiments on the oxidation of quinine, quinidine, cinchonine, and cinchonidine. As reference is made in this paper to our work upon the same subject in such a manner as to lead to the inference that we had copied Hoogewerf and Van Dorp, we beg to call attention to the dates of publication of the various memoirs relating to the matter.

In the Berlin *Berichte*, x. 1936 (close of 1877), Hoogewerf and Van Dorp published a preliminary note on the oxidation of aniline, toluidine, and quinine, and stated that they had obtained amongst other products of oxidation of quinine a nitrogenous acid, to which apparently they attached little importance. Of this acid they gave no further account. At that time we were working at the same subject, and had come to some important conclusions.

As Hoogewerf and Van Dorp's results contained nothing relating to quinine in addition to what had been observed by Cloez and Guignet many years previously, we did not consider that they were entitled to claim that this field of work should be reserved for them. We therefore sent our paper to the Chemical Society, before which it was read on January 10, 1878 (see also Berlin *Berichte*, xi. 324). In this paper we stated that the acid obtained by us from quinine was probably identical with dicarbopyridenic acid. That the acid was a pyridenic acid we had no doubt, but owing to the difficulty of purification we had not been able to establish its formula with certainty.

In the Berlin *Berichte*, xii. 158–161, was published a second paper by Hoogewerf and Van Dorp (read before the Berlin Chemical Society on January 27, 1879), on the acid obtained from quinine, giving no analyses, but stating that the acid was *tri-* and not *di*carbopyridenic acid, thus confirming our result in its important bearing, viz. the connection between the quinine and pyridine series. In the same paper they suggested that an acid obtained by them from quinidine and cinchonine was identical with the quinine acid.

Immediately on receipt of the number of the Berlin *Berichte* containing Hoogewerf and Van Dorp's paper, we forwarded to the secretary of the Chemical Society our second memoir, which contained numerous analyses of the acid obtained, not from quinine only, but also from the allied alkaloids, quinidine, cinchonine, and cinchonidine, together with a full description and analysis of all its important salts. That paper was read before the Society on February 20, 1879.

In *Liebig's Annalen*, cciv. 84–118 (July 31, 1880), or a year and a half after the publication of our second paper, Hoogewerf and Van Dorp published analyses of the acid and many of its salts, prepared from three alkaloids, the results confirming our own in all points.

Our claim, which the above dates fully substantiate, is to have been the first to establish the connection between the quinine and pyridine series, and to have proved that the four alkaloids all gave the same oxidation product.

Prof. Butlerow of St. Petersburg, immediately on appearance of our first paper, when engaging in work closely connected with, but not overlapping ours, wrote suggesting that we should

each confine himself to his own branch, at the same time recognising the importance of our discovery; and Herr Konig, in a paper published in the *Berichte*, xii 97, referring to our first paper, says: "Es ist der erste glatte Uebergang der Chinaalkaloide in eine jedenfalls einfachere Substanz—das Pyridin."

WILLIAM RAMSAY
JAMES J. DOBBIE

Glasgow University

The Temperature of the Breath

DR. DUDGEON'S first letter under this heading contained the suggestion of a friend that his enigmatical thermometric readings were to be accounted for by the high temperature "caused by the condensation of the moisture of the breath by the silk handkerchief." The discussion that followed has not only brought us back to this solution, but has also furnished us with an authoritative expression of opinion that the clinical thermometer is not sensitive to pressure. F. J. M. P. first hinted the contrary proposition only to have it thrust aside by Dr. Dudgeon with blunt denial, neglected by Dr. Roberts, and finally discarded by himself for no other apparent reason than that aqueous vapour in condensing liberates heat. Yet I venture to assert that readings as high as any obtainable by Dr. Dudgeon's method, less the pressure, can be obtained by a very similar mode of experimenting, without the developed heat. 1. If the bulb of a thermometer, protected by paper or other non-conductor, be squeezed in an intermittent manner between finger and thumb, it will be found that the mercury can readily be made to dance up and down through about a degree on the scale with a celerity not attributable to changes of temperature. 2. If eighteen inches of cotton thread be tightly wound about the bulb, on immersing the thermometer in water it will exaggerate the temperature sometimes by as many as 12° F. 3. If a tube filled with cacao butter be substituted for the thermometer the butter beneath the thread will be longer in melting than that in other portions of the tube, a result which I think proves that the high readings of experiment No. 2 are not temperature, but (in the light of No. 1) pressure readings.

My chief object in writing is to protest on general grounds against the treatment accorded to F. J. M. P.'s suggestion, but at the same time I wish to express my opinion that Dr. Roberts' argument would have been strengthened by giving heed to it, for I see nothing in *his account* of the interrupted experiment not explainable on the pressure hypothesis alone, the descending series of readings being perchance due to a yielding of the wrappings under prolonged tension. On the other hand I have to thank this omission on Dr. Roberts' part for having induced me to test the subject for myself, and thus experience, in repeating his experiment, the rare pleasure of scientific surprise at seeing the index mount higher and higher above the level of my expectations under conditions which left no doubt as to the cause being a rise of temperature. Dr. Dudgeon has done good service by directing attention to a simple experiment which, properly interpreted, throws new light on the philosophy of clothes, and should prove a telling shaft in the quiver of popular science.

WM. MCLAURIN

Islington, December 26, 1880

IN the number of NATURE which reached Madras after the departure of the mail conveying my letter of the 9th inst., I was glad to read Dr. W. Roberts' abundantly full and lucid explanation of the heat produced by breathing on thermometers enveloped in hygroscopic substances. He has, by a very simple method, confirmed the view endorsed in my communication in NATURE, vol. xxiii. p. 534.

That the effects of friction and of compression of air are so slight that they may be disregarded, has been proved; and the rise has been clearly traced to absorption of aqueous vapour. It has yet to be determined how much of this heat may be accounted for by the reduction of aqueous vapour to the fluid state, and how much by capillary action and absorption of water, with or without chemical union, and its reduction to the solid state—all of which may be included in hygroscopic action. This determination would involve some intricate investigations which some scientific specialist may perhaps find leisure to undertake. That more than simple vapour condensation is concerned in the production of hygroscopic heat is shown by the rise of temperature on adding water to a non-saturated hygroscopic substance.

A scientific colleague has suggested to me that some cases of very high axillary temperatures may be explained by the clothing of patients being pressed into the axilla in contact with the thermometer. Thus, by folding a banian round a thermometer placed in the axilla, I registered a temperature above 100° F., while the temperature in the bare axilla was 98.3. It is evident that recently changed and dried clothing and clothing warmed by the body of a non-perspiring fever patient would have still more effect when pressed closely into a hot and moist axilla. Although this point is important mainly to physicians, I venture to draw attention to it through your columns on account of its connection with the subject of hygroscopic heat.

C. J. MCNALLY

Madras, December 16, 1880

Distance of Clouds

I HAVE conveniently determined the distance of passing clouds by a method probably not new, but which I have not seen described.

It consists in ascertaining the velocity with which the shadow of a cloud traverses level ground, which is easily observed, and of course gives the velocity of the cloud itself.

The angular motion per second of clouds passing overhead is simultaneously observed by means of a coarse micrometer in a telescope, or with a theodolite.

The distance is thus obtained with fair approximation.

$$\text{Distance} = \frac{v\,t\,3438}{n},$$ v being the velocity in feet per second, and n the number of minutes of arc described in t seconds.

A distant mirror may be advantageously used in determining the velocity of the shadow.

EDWIN CLARK

Fluke in Calves

CAN any of your readers account for the following facts?—An examination of the liver of some six-weeks-old calves which had never touched any food but their mother's milk showed them to be infested with fully-developed Fluke (*Distoma hepatica*). It is clear that the presence of these flukes does not admit of the usual explanation, viz., the ingestion with green food or water of mollusca bearing the larva in one of its earlier stages.

I should be grateful if any of your readers could suggest an explanation of the mode in which the fluke entered the liver of the calf. Is it possible that the larva may have passed into the milk of the mother, and so have entered the stomach of the calf?

It may interest some of your readers to know that traces of fluke were present in the livers of cattle lately killed when in high condition. The fluke had apparently been established in the liver some considerable time previous to the slaughter of the animals, and had perished on their attaining to a state of high health and vigour.

A. B.

JOHN STENHOUSE, LL.D., F.R.S.

IN the early morning of the last day of the old year we lost one of the few surviving founders of the Chemical Society, Dr. John Stenhouse. He was born at Glasgow, October 21, 1809, the son of William Stenhouse of the well-known firm of calico-printers, John Stenhouse and Co. of Barrhead. He was educated first at the Grammar School and then at the University of Glasgow, and long resided in his native city. At an early age he turned his attention to chemistry, and diligently studied that science under Graham and Thomson, and subsequently with Liebig at the University of Giessen. When he removed to London, after the failure of the Western Bank of Scotland had deprived him of the fortune bequeathed to him by his father, he became Lecturer on Chemistry in St. Bartholomew's Hospital, London, but was obliged to resign that appointment in 1857 owing to a severe attack of paralysis. Even this affliction however did not discourage him, and after the lapse of a short time he renewed his scientific labours. In 1865 he succeeded Dr.

Hofmann as non-resident Assayer to the Royal Mint, but was deprived of the appointment by Mr. R Lowe, who abolished the office in 1870.

A pupil of Graham and Liebig, he had all their enthusiasm for scientific investigation, and devoted nearly the whole of his time to research work in the domain of organic chemistry the eminence he attained in this branch of science is fully recognised, but his contributions to our technical knowledge are not so well known He was the author of many ingenious and useful inventions in relation to dyeing, sugar manufacture, tanning, &c, but the greatest and most permanent has been the application of charcoal for disinfecting and deodorising purposes, which took the form of charcoal air-filters for the ventilation of sewers, and the charcoal respirator, the best of all respirators, not only for preventing the deleterious effects of noxious gases in numerous manufacturing operations, but also for the protection of those subject to bronchitis, asthma, and other similar diseases

It is impossible in our limited space to give even an outline of the numerous investigations which he published during his long scientific career, extending as it did over a space of more than forty years The results are embodied in about 100 papers, published in various scientific journals, English and foreign; they relate in great part to what may truly be called "organic chemistry"—the chemistry of carbon compounds formed by organised bodies John Stenhouse was LL.D of Aberdeen, a Fellow of the Royal Society, which awarded him the Royal Medal in 1871, one of the founders of the Chemical Society, and a Fellow of the recently-established Institute of Chemistry Of his personal character those who knew him intimately could never speak too highly, his death will be felt and mourned not only by his many personal friends, but also by men of science throughout Europe.

WILHELM HEINTZ

WE recently recorded the death, at Halle, on December 1, of Prof. W Heintz, one of the leading German chemists of our day He was born at Berlin, November 4, 1817. His earlier university studies were undertaken with a view of becoming a pharmacist, but this intention was relinquished as the attractions of a more purely scientific career were offered to him In 1844 he received the doctor's degree at the Berlin University, and two years later he was admitted as privat-docent in the philosophical faculty of the same university In 1850 he accepted a call to Halle as the successor of the well-known Marschand; and here, after passing five years as an extraordinary professor, he was appointed in 1855 to the full professorship of chemistry, and the directorship of the newly-built laboratory, posts which he occupied at the time of his death

As a teacher and as a guide to students inclined towards chemical research, Prof. Heintz evinced more than ordinary capacity, and for a quarter of a century he has ably maintained the reputation of Halle among the centres of chemical interest in Germany. This reputation is due in no small part to his own personal contributions as an investigator, for few chemists of our day have manifested such unwearied energy and long-continued application, such thoroughness of work, accuracy of observation, and widespread familiarity with fact and theory as are evinced in Heintz's manifold and diversified researches.

The earlier portion of his career was directed to the solution of problems in physiological chemistry. Among his more important researches in this direction mention should be made of those on the juice of the *Galactodendron* (1845), on kreatin and kreatinin (1847), on lactic acid in the gastric juice (1849), on the composition of bones, and on cholesterin (1850), on the colouring matter of gall stones (1851), on urinary sediments (1862), and more especially on the animal and vegetable fats. This latter research, extending over a period of about seven years, includes exhaustive studies on the physical properties of the fats, methods of their separation, their chemical constitution and nature, the products of their decomposition, &c His careful observations of the melting points and composition of the fatty acids in the pure state and when mixed with each other, form essentially the basis of our present knowledge on this subject, and enabled him at the time to show the composite character of various fats which preceding chemists had regarded as pure compounds

In analytical chemistry Heintz devised a variety of methods and modifications of methods, amongst which mention may be made of his contributions on the estimation of sulphur in organic bodies, on the separation of magnesia from the alkalies, on the analysis of ashes (1847), on the determination of urea and uric acid, on the detection of gall (1848), on the determination of nitrogen (1851), on the estimation of phosphoric acid, and numerous analytical data

In inorganic chemistry his researches were chiefly confined to studies on a variety of phosphates, on bismuth and uranium salts, on the preparation of cæsium and rubidium compounds (1865), on the combustion of ammonia in oxygen (1864), on the silicates of the alkaline metals, and to the examination of the minerals margarite, stassfurtite, carnallite, aluminite, and boracite, the latter of which he prepared artificially (1860)

It is however in the field of pure organic chemistry that Heintz's discoveries have been most numerous and important They commence with his investigation on saccharic acid, begun in 1844 and resumed in 1858-1860, to which we owe a great measure of our knowledge of this acid, and especially of its salts and ethers This was followed in 1856 by a study on the action of chloride of sulphur on the salts of organic acids, in which he recorded the unvarying and simultaneous formation of chlorides and sulphates at the expense of the organic salts In 1859 he began his extensive research on glycollic acid, which occupied much of his time until 1872, by exposing monochloracetic acid to the action of various sodium alcoholates, obtaining thereby the different ethers of glycollic acid, thus with sodium ethylate

$$CH_2Cl\ COOH + NaOC_2H_5 = NaCl + \begin{array}{l} CH_2\ OC_2H_5 \\ | \\ COOH \end{array}.$$

By means of this prolific reaction he obtained a number of interesting derivatives of the acid in question Closely allied to them were the acid ethers of glycollic acid, obtained by submitting monochloracetic ethers to the action of salts, or by acting upon glycollic ethers with such bodies as phosgene or chlorocarbonic ether Among the other important compounds discovered by him in this group are glycolamide, glycol-ethyl-amide, diglycollic acid—$O(CH_2\ COOH)_2$ obtained by the action of sodium hydrate on monochloracetic acid, diglycoll-diamide, diglycollamic acid, &c During this same period he made noteworthy investigations on the ethyl-amines, on sulphocyan-acetic acid and its derivatives, on nitrate of ethyl, on ethyl-hydantoin, on lactic acids, and on the amido-acids obtained from chloropropionic and iodopropionic acids by the action of ammonia With 1874 commences his last important research—that on the aceton bases, the simplest of which result from the action of ammonia on aceton While forced to overcome manifold difficulties in the prosecution of this investigation, Heintz succeeded in isolating a number of novel and important compounds, especially interesting from a theoretical point of view The leading forms embraced in this new group are diacetonamine, triacetonamine, the corresponding alcohol bases diaceton-alcamine and

triaceton-alcamine, benzal-diacetonamine, amido-trimethyl-oxybutyro-nitrile resulting from the action of prussic acid on diacetonamine, and amido-dimethyl-acetic acid, obtained by the oxidation of diacetonamine; while a paper published a few months since describes a new aceton base containing sulphur. Prof. Heintz's activity was manifested up to within a few months of his death In addition to the paper just alluded to his contributions to chemical literature during the year just closed include articles on triaceton-diamine, on the existence of acetonine, on two compounds of urea with chloride of gold, and on diethidene lactamic acid.

Prof Heintz was the recipient in 1862 of the honorary degree of M D. from the University of Konigsberg in recognition of his services to physiological chemistry In 1876 he was elected an honorary member of the London Chemical Society T H. N.

SMOKE ABATEMENT

A MEETING was held in the Egyptian Hall at the Mansion House on Friday last, under the presidency of the Lord Mayor, to consider the best means of remedying the evils arising from the present smoky condition of the atmosphere of London Among those present were Mr G J Shaw-Lefevre, M P (First Commissioner of Works), Mr W Spottiswoode (President of the Royal Society), Dean Stanley, Sir U. Kay-Shuttleworth, Dr Farquharson, M P, Mr Ernest Hart (Chairman of the joint committee of the Health and Kyrle Societies), Col Festing, R E, Dr. Alfred Carpenter, and Prof. Chandler Roberts

Mr Ernest Hart, in explaining the objects of this movement, said that some practical advance had already been made It was not pretended that fogs could be prevented, but since smoke added opaqueness and corrosive and other deleterious qualities to London fogs, much might be done to diminish the discomforts and evils we suffered from this cause Having described the objects proposed to be attained by an exhibition of apparatus and smokeless fuel, he gave the results of some calculations in order to bring home to the minds of his hearers the enormous waste of money involved in the present arrangements for heating houses

Mr Spottiswoode stated that a committee of the Royal Society had been appointed to investigate the facts connected with the formation of fog, but while we looked to science to tell us what was wanted to improve our atmosphere, we looked to the legislature to carry out those effectual preventive measures which all hoped would some day or other be devised Nevertheless, without the strenuous aid and co-operation of every householder the best legislation could be turned to but little account In conclusion he moved, "That it is the opinion of this meeting that the smoky condition of the atmosphere of London injuriously affects the health and happiness of the community, besides destroying public buildings, deteriorating perishable fabrics, and entailing in various ways unnecessary expenditure"

Sir Frederick Pollock seconded the resolution, and urged that much might be done if every one who had an old fire-grate to replace would provide one of an approved and really more economical pattern.

Mr. G J Shaw Lefevre moved, "That this meeting is further of opinion that the injurious effects of fog are largely due to the quantities of smoke given forth from the chimneys of furnaces, manufactories, and steam-vessels, as well as dwelling-houses, and that the smoke in the metropolis might, without any considerable difficulty, be greatly lessened by the better enforcement of the existing law, by the introduction of amended legislation, and by the general use in all descriptions of premises, including dwelling-places, of proper smoke-preventing apparatus, improved household stoves and grates, or of smokeless fuel" As the head of the public department responsible for the public works of this great metropolis, he need hardly assure those present that he was deeply impressed with the importance of the subject under discussion. The importance of pure water was often insisted upon, but surely pure air was even more important Yet, for years past, it must be admitted that the air of London had been getting worse, and fogs were denser and of longer duration than formerly, even invading the summer months There could be no doubt that forty or fifty years ago London was famous for its roses, now it was impossible to get the rose to blossom here, and it was all but impossible to get any of the conifers to grow in the darkness of the London atmosphere He should, however, deprecate any hasty attempts to legislate Much might be done by the extension of the existing Acts relating to the abatement of the nuisance from smoke, and he thought Government might be rightly called upon to give some additional facilities for the purpose of enforcing those Acts It was monstrous that in these days so many factories should not be consuming their own smoke, and, since there was a great economy in the use of appliances which prevented this waste of fuel, there was no hardship in enforcing the Act When they came to the question of the domestic consumption, he thought it would not be wise to attempt to interfere by any legislation They must rather trust to persuasion and example and inducements His own hope was in the introduction of some other heat-giving apparatus Doubtless the substitution of anthracite for north-country coal would be an advantage; but he did not see the means of persuading the enormous mass of householders to use the smokeless coal unless it could be distinctly proved to them that there would be economy in the change. He would suggest that it might be worth while for the gas companies to turn their attention to the production of gas for heating purposes He could not help thinking that the time was not very far distant when not only our streets and public buildings, but also our private houses, would be lighted by electricity There were non-luminous gases suitable for heating purposes, which might be made at a much less cost than the gas at present supplied for lighting. From a friend he had learnt that water-gas, which could be made at a low rate, was used in many towns in America for heating purposes. Every one could do something to help forward this good work of abating smoke, and for himself he would promise to use his efforts in the department with which he was connected to diminish the nuisance from smoke. When he mentioned that some 20,000 tons of coal were purchased annually by the department, the meeting would appreciate the extent to which the public offices added to the smoke in the atmosphere of the metropolis. He hoped the time would not be far distant when they would have restored the atmosphere of London to its early purity, the blossom to our London roses, and the bloom to the cheeks of our London children

Dr Alfred Carpenter urged that this was a question particularly affecting the middle class and the poor, the waste of fuel at present being deplorable. He moved "That this meeting approves the proposal of the joint Committee of the National Health and Kyrle Societies to hold an exhibition, by permission of Her Majesty's Commissioners for the Exhibition of 1851 and the other authorities, in buildings erected for the International Exhibition of 1862, of the various smokeless coals and other fuels, and of various appliances applicable to household and manufacturing purposes for the reduction of smoke, and to test the same, in order to demonstrate for public information the means practically available to secure that object This meeting is of opinion that the investigation and testing should precede any application for amendment of the existing Smoke Acts, or for new legislation in regard to smoke from dwelling-houses."

THE INDO-CHINESE AND OCEANIC RACES—TYPES AND AFFINITIES[1]

III.

IN the accompanying series of illustrations the late King of Camboja (Fig 14) and the Stieng of the forest region east of the Me-Khong, between 12°–13° N. lat (Fig. 15), may be compared, on the one hand, with the famous statue of the leprous king, Bua-Sivisi Miwong (Fig. 16), the traditional builder of the temple of Ongkor-Vâht, and on the other with the first King of Siam and his late Queen (Figs. 17 and 18). Here the resemblance of Figs 14, 15, 16 to the European type and difference from the Mongoloid Siamese (17 and 18) is too obvious to need further comment. For these illustrations from Mouhot's "Travels in Siam, &c ," I am indebted to the courtesy of the publishers, Messrs Murray, Albemarle Street

The Caucasian element in Indo-China differs from the Mongoloid quite as much in speech as it does in other respects. Here the Mongol races, as already stated, all speak monosyllabic toned languages , but the Cambojans and kindred peoples all speak polysyllabic untoned languages, a fact scarcely yet recognised even by the best-informed philologists Taking the Khmêr as the typical language of this group, it will be convenient here to establish its polysyllabic character, reserving the question of its true affinities till we come to the allied races of Malaysia and Polynesia. The so-called monosyllabic or isolating family of languages—Chinese, Tibetan, Annamese, Siamese, Laos, Khasia, Shan, Burmese, Khyeng, Karen, Talaing, Kuki, and most of the innumerable Himalayan dialects—must all be regarded as at present reduced to a state of profound phonetic decay Whether originally they were all essentially monosyllabic, possessing, like the Aryan, roots of one syllable only, it is very difficult to say , but it seems certain that they were not originally toned In fact there can be no reasonable doubt that the tones are a later development, worked out unconsciously to preserve distinctions between words that had assumed the same form by loss of initial or final letters Thus in Chinese the final letters *m, k, t, p* have disappeared in the correct Mandarin dialect, causing roots like *kom, kok, kot, kop* all to assume the form of *ko*, toned four different ways according to the sense

This principle, which, combined with the absence of inflection or root modification, constitutes the very essence of the monosyllabic system, pervades the whole family. But it is absolutely unknown in the Khmêr group, in which words, whether monosyllables or polysyllables, are always uttered without intonation, as in all other languages. Its polysyllabic character was not recognised by Francis Garnier, but it has been abundantly demonstrated by Bouillevaux and Aymonnier, and will be made evident further on But because the Cambojans are of Caucasian, and their speech of polysyllabic, type, it does not follow that the Cambojan must be an Aryan language As already pointed out, within the Caucasian ethnical, there are several fundamentally distinct linguistic groups, which are now past reconciliation. To attempt to affiliate Cambojan with Sanskrit must necessarily end in failure, as did Bopp's attempt to include the "Malayo-Polynesian" in the Aryan family It must always be remembered that man is at least a quaternary, if not a tertiary animal, consequently that human speech is probably several hundred thousand years old. This period has been too short to evolve more than perhaps three or four really distinct physical types, but it has been long enough to evolve perhaps hundreds of really distinct linguistic types, many now extinct, some lingering on in contracted areas and remote corners, several, like the Sorb of Lusatia and the Pyrenean Basque, actually dying out, some few, like the Chinese, Russian, Spanish, and especially English, absorbing most of the rest, and threatening to divide the world between them.

[1] Continued from p 224

B —CAUCASIAN TYPE—(*Continued*)

V. OCEANIC BRANCH. *Indonesian and Sawaiori, or Eastern Polynesian Groups*

All the Oceanic peoples, other than the dark races of Class A, are commonly grouped together under the collective term "Malayo-Polynesian." By this name are consequently understood all the yellow, brown, or olive-brown inhabitants of Malaysia and the Indian and Pacific Oceans, that is to say, all varieties of Malays in Malacca and the Dutch East Indies, the Malagasy of Madagascar, the Philippine Islanders, the Micronesians, the natives of Formosa and the large brown Eastern Polynesians. The expression was originally proposed by William von Humboldt, merely in a linguistic sense, to designate the group of fundamentally connected languages, which really prevail amongst all these widely diffused peoples. But, like Aryan and so many other similar terms, it gradually acquired an ethnical meaning, and most ethnologists now take it for granted that there is a Malayo-Polynesian race, as there is a Malayo-Polynesian speech But such is not the case, and as on the mainland, so in the Oceanic area, the presence of the two distinct Caucasian and Mongolian types must be recognised and carefully distinguished It seems hopeless to do this as long as the misguiding expression Malayo-Polynesian continues to figure in scientific writings While retaining Malay for the typical olive-brown Mongolian element in the Eastern Archipelago, I have elsewhere proposed *Indo-Pacific* for the brown Caucasian element in the Indian and Pacific Oceans, and *Sawaiori* for the large brown Polynesians, constituting the eastern and most important branch of that element

It has already been remarked that the Caucasians are the true autochthones of Indo-China They seem to have also preceded the Mongol migration to the Archipelago, no doubt driven thither by the continual pressure of the Mongols advancing southwards and eastwards from High Asia. In the Archipelago they occupied chiefly the large islands of Sumatra, Borneo, Gilolo, and Celêbes, here probably exterminating the aboriginal Negrito tribes But here also they were followed by the Mongols from the mainland, with whom some amalgamated, producing the present mixed races of Western Malaysia, while others migrated eastwards to their present homes in the Eastern Pacific Here they occupy almost exclusively all the islands east of a line running from Hawaii through Samoa to New Zealand, those groups included West of that line they are found mostly blended with the Melanesians, as explained in Section II , but also in a pure state at a few isolated spots such as the Ellice and Phœnix Islands, Rotuma and Uvea in the Loyalty group They are also found blended with the Malay and other elements in Micronesia

That this large brown race reached the Pacific from the west there can be no reasonable doubt, and this view is now consequently held by Hale, Flower, Whitmee, de Quatrefages, and most recent ethnologists I Muller and de Quatrefages have even identified their legendary *Pulotu*, or Western Island of the Blest, with *Buro* in Malaysia, which is accordingly taken as their probable starting-point. But from whatever place they set out, they seem to have settled first in Samoa, which may therefore be taken as their second point of dispersion "From this centre, and more particularly from the Island of Savaii, the principal of the group, their further migrations may be traced with some certainty from archipelago to archipelago through the uniform traditions of the various groups. In these traditions Savaii[1] is constantly

[1] This word *Savaii* has by some been identified with *Java* But the primitive form seems undoubtedly to have been Savaiki in which both *s* and *k* are organic On the other hand Java is the Sanskrit *Javak* for *Djavak*, the two-stalked barley, where the initial organic is *d*, dropped as in the Latin *Janus* for *Dianus* (root *dus*) Besides although there are many Sanskrit words in the Malay dialects there are none in the Sawaiori, the Caucasians having migrated eastwards long before the appearance of the Hindus in the Archipelago Hence although they may have

FIG 14—Caucasian Type, Indo China King of Camboja.

FIG. 15—Caucasian Type, Indo-China Stieng Savage, Cochin China

referred to under diverse forms as the original home of the race, or otherwise persists, as shown in the subjoined list, which will also serve to illustrate the permutation of letters in all these closely-connected dialects :—

SAVAIKI.—Organic Sawaiori form of the word.

SAVAII.—The Samoan form; here still the name of the island referred to in the Sawaiori traditions.

HAVAII—The Tahitian form; here "the universe," "the world" in the national odes, also the old capital of Raiatea Island.

AVAIKI—The Rarotonga form; here "the land under the wind."

HAWAIKI.—The Maori form; here the land whence came the first inhabitants of New Zealand.

FIG 16—Caucasian Type, Indo-China Statue of the Leprous King, Founder of Ongkor-Vâht, Camboja.

HAVAIKI—The Marquesas form; here "the lower regions of the dead" Over the victims in human sacrifices are uttered the words, "To fenua Havaiki" = Return to the land of thy forefathers

HAWAII.—The Sandwich form; here still the chief island of the group.

HEAVAI.—The form in chart published by R. Forster in vol. v. of Cook's Second Voyage, and based on information furnished by Tapaia, a native of Tahiti, who had no personal knowledge of Samoa.

HEAWIJE.—The form given by Cook in his account of his first visit to New Zealand (1770).[1]"

started from Java, they could not have carried its present name with them. I note that Prof Sayce now identifies *Janus* with the Etruscan *Ani*, accounting for the *J* by assimilation with *Janua* (*Academy*, August 21, 1880). But is not *Janua* itself a derived form from *Janus*, whence also *Jannarius*?

[1] "Philology and Ethnology of the Inter-Oceanic Races," by A. H. Keane, in Stanford's "Australasia," 1879.

Dates have even been assigned for these various migrations. Thus we are told that the Polynesians made their appearance in the Marquesas Islands about the beginning of the fifth century A.D., in Tahiti about 1100, in Rarotonga about 1200, in New Zealand about 1400, and so on. But all this, depending on the oral genealogies of the chiefs, and other equally unreliable data, must be regarded as pure conjecture. More probable is the statement that the race appeared in Malaysia over a thousand years before any mention occurs of Malays in that region. At the same time it is idle to attempt assigning dates to strictly prehistoric events, with the correct sequence of which we are more concerned.

The Sawaiori are one of the finest races of mankind, Caucasian in all essentials, and without a trace of Mongolian blood. Observers, from Cook to the members of the *Challenger* Expedition, are unanimous in describing them as distinguished by their fine symmetrical proportions, tall stature, handsome and regular features. Cook gives the palm to the Marquesas Islanders, who, "for fine shape and regular features, surpass all other natives." The Samoans and Tahitians are very little inferior, and even of the Tongans (Friendly Archipelago) Lord George Campbell remarks — "There are no people in the world who strike one at first so much as these Friendly Islanders. Their clear, light copper-brown coloured skins, yellow and curly hair, good-humoured and handsome faces, their *tout ensemble*, formed a novel and splendid picture of the *genus homo*, and as far as physique and appearance goes they gave one certainly an impression of being a superior race to ours." Their average height is five feet ten inches, ranking in this respect next to the Tehuelches of Patagonia; they have smooth but not lank hair, often curly and wavy, and Mr. Staniland Wake has recently shown that, against the commonly-received opinion, the beard is naturally full, though often artificially removed. Add to all this a cheerful joyous temperament, a frank and truthful disposition and kindly nature, and you have a type as different as it is possible to imagine from the Mongolian, and consequently from the true Malay. Yet the Sawaiori and Malays are grouped together under the collective designation of "Malayo-Polynesians," as if they were merely two varieties of a common stock. All they have in common are one or two cranial features, of no particular value as racial tests, at least when taken apart, and the elements of their language, which we shall see is in this instance no racial test at all. The true affinities of the Sawaiori are with the Caucasians of Indo-China, and with that fair element in Malaysia which Dr. Hamy proposes to group as Indonesians, and whose relations to the Eastern Polynesians he has been one of the first to perceive. Noteworthy amongst these Indonesians, Pre-Malays, or Indo-Chinese Caucasians still unaffected by Mongol influences in the Archipelago are the Mentawey Islanders, who, though occupying the Pora Group some seventy miles off the west coast of Sumatra, are none the less closely related in physique, language, and customs, to the Eastern

FIGS. 17, 18.—Mongoloid Types, Indo-China. King and Queen of Siam.

Polynesians. On this point the testimony of C. B. H. von Rosenberg is decisive. "On a closer inspection of the inhabitants the careful observer at once perceives that the Mentawey natives have but little in common with the peoples and tribes of the neighbouring islands, and thus as regards physical appearance, speech, customs, and usages, they stand almost quite apart. They bear such a decided stamp of a Polynesian tribe that one feels far more inclined to compare them with the inhabitants of the South Sea Islands."

From this point of view it will be instructive to compare the native of Pora, Mentawey Group (Fig 19), with the Battas of Pak-Pak, Sumatra (Figs. 20 and 21), all from von Rosenberg's "Malay Archipelago," vol. i. pp 56 and 192. Owing to their splendid physique and "Caucasian features" Junghuhn and Van Leent take

FIG 19 —Caucasian Type, Malaysia. Mentawey Islander

these Sumatran Battas as the typical unmixed or pre-Malay element in the Archipelago, whom they would accordingly group collectively as the Batta race The form *Battak* often occurs, but this is simply the plural of Batta, so that to write *Battaks*, as many do, is a solecism. Compared with the Malays proper, the Battas are tall and muscular,

FIG 20 —Caucasian Type, Sumatra Native of Batta Land

with regular features, less prominent cheek-bones, light-brown complexion, with a ruddy tinge on the cheeks, finer hair, often brown and wavy, thicker beard. When in Jilolo in 1876 M. Achille Raffray met some so-called "Alfuros" of Dodinga, who might be taken as typical specimens of this Batta or Indonesian race (*Tour du Monde*, April 12, 1879, p. 234) We therefore separate this Batta, Indonesian or Pre-Malay element in the Archipelago from the Malay element proper, affiliating the former to the Indo-Chinese and Eastern Pacific Caucasians, the latter to the Indo-Chinese Mongolians Whether the Caucasians are found in other parts of East

FIG 21 —Caucasian Type, Malaysia Native of Pak-Pak, Batta Land

Asia is a question that cannot here be discussed, but it may be remarked that even the cautious Topinard ventures to include "the Ainos of Japan, the Miau-Tz' and the Lolos of Yunnan in the European group" ("Anthropology," p 476)

C MONGOLIAN TYPE

VI. CONTINENTAL BRANCH. *Indo-Chinese Group*

VII OCEANIC BRANCH *Malayan Groups*

The main features of the continental branch of this division are too well known to need special comment here. What we are more immediately concerned with is its relation to the Oceanic section, and this relation will come out the more clearly if both are treated together. To avoid misconception, it may be well to observe that a portion only of the Continental branch is comprised in the Indo-Chinese group, for there are many other groups, such as the Mongolian proper, the Manchurian, the Tatar or Tûrkic, the Japanese, the Corean, the Finnic scattered over the greater part of Asia and penetrating westwards to the Baltic seaboard and Middle Danube basin. All these must be held, apart from the question of miscigenation, to belong to one primeval stock, constituting the Yellow or Mongolian division of the human family. We are all familiar with its essential characteristics flat and broad features, prominent cheek-bones, short broad and flat nose, black almond-shaped and oblique eyes, long black and lank hair nearly cylindrical in section, little or no beard, low stature averaging about 5 feet 4 inches, dirty yellow or tawny complexion, slightly prognathous and more or less brachycephalous head.

This description corresponds substantially with the ordinary Malay type, such as we see it in Java, Bali, Madura, many parts of Sumatra, round the coast of Borneo, and in the peninsula of Malacca The true aborigines of this region, as shown in a previous section, were the Negritos; consequently the Malays, like the

pre-Malays or Caucasian Indonesians, are here intruders Intruders from where? Obviously from where the type exists, the neighbouring Indo-Chinese peninsula What then becomes of the Malay as a primary division of mankind? As such it can no longer be recognised in anthropology, and must sink to the position of a mere variety of the Mongol type. The so-called true Malay or typical Malay is essentially a Mongolian, and the likeness between the two has not failed to strike all careful observers "The Malayan race," says Wallace, "as a whole undoubtedly very closely resembles the East Asian populations from Siam to Manchuria. I was much struck with this, when in the Island of Bali I saw Chinese traders, who had adopted the costume of that country, and who could then hardly be distinguished from Malays, and on the other hand I have seen natives of Java who, as far as physiognomy was concerned, would pass very well for Chinese" Hence De Quatrefages rightly rejects the claim of the Malays to be regarded as a fundamental type "All polygenists," he remarks, "have regarded the Malays as one of their *human species*, many monogenists have considered them as one of the principal races I showed long ago that in reality they are only a mixed race in which white, black, and yellow elements are associated"

The last clause of this sentence gives the true solution of the problem The inhabitants of Malaysia consist not of one, nor even of three distinct races, but of three races variously intermingled, the yellow or Mongolian, and the white or Caucasian chiefly in the west, these two and the black or Papûan chiefly in the east. As the fusion of yellow, white, and black produces the so-called "Alfuros" in the east, so the fusion of yellow and white produces the so-called Malays in the west The more the yellow prevails the nearer do the Malays approach the Mongol type, the more the white prevails the nearer do they approach the Caucasian type, until in some places they seem to be no longer distinguishable from the Mongols, in others from the Caucasians The Javanese are taken for Chinese by Wallace, just as the Mentawey Islanders are taken for Sawaiori or Eastern Polynesians by von Rosenberg Under these circumstances it is not surprising that those who seek for unity in the Archipelago should meet with nothing but confusion Prof Flower comments on the divergent characteristics presented by the Malayan crania, remarking that "there is certainly no very great conformity in the characters of the skulls in our collections which are said to belong to Malays" This must always be the case until we come to an understanding as to the meaning of the term Malay, which after all is far more a national and linguistic than a racial expression Proceeding on the groundless assumption of a common Malay type in Oceanica, Welcker arrived at the subjoined astonishing results from cranial measurements in Micronesia and Malaysia alone.—

Length of Skull 100

	Index of breadth	Index of height	Difference
Caroline Islanders	68	74	+ 6
"Alfuros"	74	79	+ 5
Dyaks of Borneo	75	77	+ 2
Balinese	76	77	+ 1
Amboynese	77	77	+ 0·4
Sumatran	77	78	+ 1
Macassar	78	78	− 0·5
Javanese	79	80	+ 0·4
Buginese	79	80	+ 0·4
Menadorese	80	81	+ 1
Madurese	82	82	− 0·1

Yet even here Sumatran is taken as a unit, although it is not hazarding too much to say that a comparison of Atyeh, Batta, Palambang, Jambi, Siak, Menangkabu, Korinchi, Rejang, Lampung, and other crania from that island alone would probably yield almost as many discrepancies as are revealed in this table. There is in fact less uniformity of type in Malaysia alone, with a population of some 25,000,000, than in the whole of China and Mongolia with a probable population of 400,000,000

A H KEANE

(*To be continued*)

A CHAPTER IN THE HISTORY OF THE CONIFERÆ

II.

GINKGO (Linnæus)

THE perhaps better known name of this genus is Salisburia (Smith), but the Linnæan name, adapted from the Chinese, has unfortunately priority. The genus contains only one existing species, the gigantic *Ginkgo biloba* of Northern China and Japan It is classified with the Taxeæ, is diœcious, and the flabelliform leaves are deciduous, leathery, very variably lobed, and of all sizes up to an extreme of five inches across The fruit, about an inch in diameter, is drupaceous, on a slender footstalk, composed externally of a fleshy layer, and internally of a hard light-coloured shell, and is somewhat unsymmetrical, owing to the abortion of one of the seeds. The foliage is like that of the maidenhair fern, but the petiole is stout, often three inches long, and distinctly articulated at the base An important characteristic in recognising the fossil leaf, besides the petiole, is that however irregularly they may be lobed, they are almost invariably primarily bilobed

Though so restricted a genus now, its ancestry is perhaps more venerable than that of any other forest tree The Carboniferous fruits Trigonocarpus and Noeggerathia are believed by both Hooker and Saporta to have belonged to some ancestral form, and even the foliage of the latter, Psygmophyllum of Schimper, approaches nearly to that of Ginkgo Baiera, beyond doubt a close ally, appears in the Permian, and Ginkgo in all probability in the bilobate Jeanpaulia of the Rhœtic of Bayreuth, but the group did not reach its maximum until the Jurassics. A few species have been described in other works, but Heer's Jurassic flora of Eastern Siberia ("Flora foss. Arctica," vol. iv) contains by far the most important contribution to their past history. Five genera are placed in the groups *Phœnicopsis*, *Ginkgo*, *Baiera*, *Trichopitys*, and *Czekanowskia*, but there is no special character uniting the latter to Ginkgo, although it is no doubt coniferous. The remains are clusters of occasionally forked acicular leaves, sheathing at the base in imbricated scales. The leaves widen in most specimens here and there into bead like expansions, inferred to have been caused by some extinct type of parasitic fungus It is thought by Heer that a detached stem bearing shortly petiolated double seeds or nuts may be their fruit. Phœnicopsis is a cluster of separate leaves, also sheathing in scales at the base, but forming a fine palm like foliage, thought by Heer to unite Cordaites and Baiera, yet without any direct affinity with Ginkgo

The most aberrant of the genera obviously belonging to the group is Trichopitys of Saporta. In this the leaves were smaller, with fewer veins, and the parenchyma reduced to a narrow expansion margining each vein Although so extreme a modification of the normal type, *T setacea*[1] possesses the characteristic bilobation and petiole. Its affinity is best traced through *G. concinna*, which is similar, but with the segments of the leaves expanded to receive two to three veins each

G. sibirica and *G. lepida* are separated on trivial grounds not supported by the illustrations, and when united furnish the chief and most abundant leaves in the deposit. These are nearly as large as in the existing species, but more digitate, and with about five veins to

[1] *T pusilla* probably belongs to some other division of the vegetable kingdom

each segment They have the venation, bilobation, and petiole of Ginkgo, yet approaching in their larger leaves to Baiera Other similar species (?) diminishing in size are *G. schmidtiana*, with about six segments, *G flabellata*, with fourteen or fifteen segments, and *G pusilla*, with a less number, and barely an inch across the base These three might probably be united into a single species The remaining form from Siberia, *G huttoni*, is less divided, having but four rounded segments, and is in that respect a nearer approach to the existing one.

The nearest, however, is *G digitata* from the Jurassic of Spitzbergen, which, but for smaller size and thicker petiole, might be placed in the existing species. Leaves from Scarborough, said to be of the same species, are larger *G integriuscula* is evidently the smaller and less lobate leaf of the same species, and the author has besides taken the unnecessary care to establish five duly named and lettered varieties, thus clearly showing that he had formed no adequate conception of the extent to which the leaves of the existing tree may vary, even on the same branch His species should be reduced, the excessive subdivision being a disadvantage and rendering the work unwieldy The author also changes the classification of the Coniferæ between the second and third volumes, and the name for this genus between the third and fourth volumes, without explanation or notice, which, in a work addressed especially to geologists, is an inconvenience

The third genus, Baiera, possesses a larger and more palm like leaf, averaging nearly five inches in radius, primarily bilobed, each lobe forking either once or twice, the ultimate segments being of uniform width and possessing four parallel veins each The leaf tapers to the petiole, which is not preserved in the engraved specimens The bilobation and venation connect it sufficiently with Ginkgo, and the persistence of these characters throughout the whole group, which would hardly have been suspected to have a morphologic value, is peculiarly remarkable

There is a marked diminution in the group in the Cretaceous Baiera from the Komeschichten is limited to vestiges of stunted form placed among the ferns, while Ginkgo appears in a starved species with small leaves and short thick petiole, described as *Adiantum formosum*, and by fragments from the Upper Cretaceous Ataneschichten, inappropriately named *G primordialis*

In the Arctic Eocenes (Miocene of Heer) Ginkgo has only, and that very sparingly, been met with in Greenland This variety so resembled *G adiantoides* of the Italian Miocenes, that Heer almost directly abandoned his specific name *primordialis*, and became doubtful even whether both should not be united with the existing species.

The small fragments figured in the Miocene Baltic flora are inconclusive, and we only again meet with it in the Miocenes as far south as Italy, the South of France, and the Mississippi[1] It has been said to occur in English Eocenes by Heer, who wrote upon the tracing of an Adiantum from Bournemouth, "this is a Ginkgo," and by Ettingshausen, who considers four seeds from Sheppey to belong to it, although less than half the size of those of the present Ginkgo, and rather materially differing Its absence otherwise in British and in French Eocenes, and in the Swiss and Austrian Tertiaries, is ascertained, for the occurrence of so distinctly-marked and easily-preserved a leaf could not well be overlooked

The very strongly-marked and exceptional characters of Ginkgo, shared by the allied extinct genera, the remoteness of its origin in the Carboniferous, its extensive development in the Mesozoic, and persistence through so many ages, seems to render it desirable to separate them from the Taxeæ into a distinct tribe Already dying out in the Cretaceous and lingering through the Tertiaries in a single species, its existence now is a mere survival

[1] Since writing the above, Saporta informs me that the supposed Mississippi species is really a Lygodium

Its home has been from time to time within the Arctic circle, yet it is scarcely proved, as Saporta says, that it actually originated there The leaf of *G digitata* from the Scarborough oolite, figured by Schimper, is far larger than any figured from Spitzbergen, and neither the foliage nor the fruit of the northern fossil Ginkgo, it appears, ever at any time approached those of the existing tree in its native habitats. It is now indigenous to the northern provinces of China, and must therefore be capable of withstanding a rigorous climate, yet the conditions in Western Europe do not appear to favour the ripening of its seed in higher latitudes than the South of France

Its distribution during the Tertiaries is instructive, and Saporta's explanation, that it existed in the north during the warm Eocene and pre-Eocene times, and descended thence across Europe as the temperature decreased, on the approach of the Miocene time, is the only one that explains the facts. To suppose with Heer that the same species lived contemporaneously and at the same level in Italy and in Disco is absurd, and would presuppose a uniformity of climate such as no natural causes could have produced at so recent a geological period J STARKIE GARDNER

NOTES

THE Roman Academy of Sciences has awarded half of the King Humbert Prize, now awarded for the first time, to the German astronomer, Dr Wilhelm Tempel, director of the Acetri Observatory at Florence, for his observations on nebulæ.

DEATH is levying heavy contributions from the students of entomology in France, more especially as regards the oldest and best known We very recently had occasion to notice the decease of Etienne Mulsant, at a ripe age. Now, we regret to have to announce the death of Achille Guenée of Châteaudun, whose name is probably more known in England than is that of any other French entomologist He died on the 30th ult (his colleague and fellow-worker, Dr Boisduval, died on December 30, 1879), in his seventy-second year Guenée was a lepidopterist His publications are very numerous The most important of all are the six volumes of the series termed the "Suites à Buffon" on some of the principal families of the *Lepidoptera* of the world, which appeared from 1852 to 1857 These volumes formed a basis for future students of *Lepidoptera*, and largely influenced those of them amongst our own countrymen The town of Châteaudun occupies a not unimportant position in the history of the Franco-Prussian war. Guenée's house was occupied by the Prussian troops. He himself took refuge in Geneva, and, true to his predilections, studied the *Lepidoptera* in the collection of the museum of that city, the results of his investigations were published. We believe that when circumstances permitted his return, his own collections were found to have suffered very little damage at the hands of his unbidden guests He was an officer of the French Academy Our Entomological Society of London elected him one of its honorary members many years ago, and his friends amongst Englishmen were not few

JOHN DUNCAN, a poor Aberdeenshire weaver, has presented to the University of Aberdeen his herbarium of nearly 1200 British plants, gathered by him all over the country from Northumberland to Banff, while acting as a harvest labourer The story of Duncan was told in *Good Words* for 1878, by Mr. William Jolly, and now it would seem that the poor and intelligent weaver is so reduced in circumstances as to be compelled to accept parochial relief Surely the University of Aberdeen ought to do something for him, and possibly some of our readers may care to send a trifle to John Duncan, Droughsburn, by Alford, Aberdeenshire.

LEIPZIG is at last to have a zoological garden. A number of citizens intend to form a company for the purpose of establishing a zoological garden on an area of twenty acres, with conservatories, &c. The civic authorities of Leipzig have given their consent, and pointed out a suitable place in the immediate environs of the city.

THE base of the Mont Cenis tunnel at the French entrance shows such ominous signs of sinking that the Paris-Lyons Mediterranean Railway Company intend to have another entrance to the tunnel bored, which is to be situated at about 1 kilometre's distance from the present entrance, and is to reach the old tunnel at a spot about 600 metres from its mouth. The work has already been commenced.

VISITORS to the Brighton Aquarium will regret to hear of the death of the fine male sea-lion (*Otaria stelleri?*), so long an inmate of the Institution. Mr. A. Crane sends us some details about the animal. Poor "Jack's" very sudden death is attributed to disease of the heart. The left lobe of that organ was found ruptured and in a state of complete collapse. His female companion is still in good health. The first offspring of the pair, a male cub, was born in the spring of 1877; the second, a dead female, in the following year. Jack was probably about twelve years of age at his death. His length was 8 feet 5 inches, maximum girth 5 feet 3 inches; fore-feet 4 feet 2 inches, and hind flippers 17 inches; greatest circumference of the head 2 feet 10 inches, frontal 2 feet 2 inches, round the jaws, under the eyes, 17 inches; weight of skin 1 cwt., of lungs 22 lbs. As the skeleton will be preserved in the Institution zoologists will be able to finally determine by means of the skull the exact species to which this male belonged. The cub born of this pair is now four years old, a fine animal 6 feet long and much larger than his somewhat diminutive and flat headed mother, to whom at present he bears most resemblance, the extraordinary prominence of the frontal bones of the skull characterising his male parent being as yet undeveloped. The tanks, Mr. Crane states, are in excellent condition, and the growth of sponges, tunicates, and development of invertebrate life generally is very remarkable. In fact to a qualified histologist and embryological student they would furnish ample material for a vacation, and doubtless yield interesting results. Facilities for study, we are informed, would be willingly accorded by the Management.

PROF. E. MORREN'S *Correspondance botanique* grows in size and in completeness. We have now before us the eighth issue (October, 1880) of this most useful botanical directory. In Europe and the United States the list of botanists, official and others, is now very full and complete; and scarcely any quarter of the globe can be named which is not represented by one or two names. Every working botanist should have it on his library table.

AT a quarter to 5 p.m. on January 5 a somewhat violent shock of earthquake was felt at Agram. It lasted about three seconds. The ground rose in wave-like curves as the shock passed over. On the previous night two slight shocks were experienced.

THE *Times* Bucharest correspondent, under date January 4, describes a curious result following the recent earthquake which passed under that city. The soil of Bucharest is a rich, black, porous vegetable mould, very springy under pressure, and carriages passing in a street cause a strong vibration in the adjacent houses. The Grand Hôtel Boulevard, however, was an exception to this general rule, and in the correspondent's room, facing the principal street, on which there is a heavy traffic, he never could feel any sensible effect from passing vehicles. During the recent earthquake the windows and crockery in less massively constructed buildings rattled very sensibly, whereas there was no audible sound produced in the hotel mentioned. Since the earthquake shock, however, this state of things has changed entirely, and every vehicle passing the hotel causes vibration in the whole building. The singular part of this change consists in the fact that the effect produced by the vehicle is precisely the same as that accompanying the earthquake. It is not a jar as previously produced in other buildings, but a sawing motion similar to that described in the correspondent's telegram relating to the late shock of earthquake. This movement is so great as to cause pictures to sway backwards and forwards on the walls, and it is equally perceptible in the rear corner rooms farthest from the street. The hotel is of brick, covered outside with mastic, which would show at once any crack in the walls. He has carefully examined the exterior of the building and there is not a crack in it. Hence, he thinks, this change in the solidity of the structure appears to be due to some effect produced in the earth underneath the building by the shock of earthquake.

THE *Daily News* Rangoon correspondent, writing on December 10, states that they had another shock of an earthquake in Burmah three days before the same day on which Agram was revisited. In Rangoon it was not severe, but the tremulous motion lasted for fully a minute and a half, and was sufficiently strong to set pictures swinging and rattling against the walls. Like those which preceded it, the shock travelled from south to north, and was felt more violently elsewhere, though in no case so intensely as to cause serious damage.

ON the 6th inst., at 4.30 a.m. Berlin time, a pretty strong shock of earthquake was felt at Rousdorf.

DR. KRISHABER of 41, rue de la Bienfaisance, Paris, writes to ask if any of our readers can give him information as to the causes of death in monkeys in a wild state.

THE appearance of the phylloxera in the Crimea has been the subject of a communication, by M. Porchinsky, to the St. Petersburg Entomological Society. It has appeared probably in consequence of vines having been imported from France, and has extended hitherto very slowly in small concentric circles. As the vineyards are situated on the southern coast of the Crimea in the shape of a narrow strip at the foot of the mountains, M. Porchinsky thinks that the devastating insect will not cause much destruction. But if it appeared on the Caucasus, especially among the numberless wild vineyards of that country, it might completely destroy the whole of the vines in the valleys of the Rion and Kura rivers.

MR. F. W. PUTNAM has made a communication to the Essex (U.S.) Institute of peculiar interest on "The Former Indians of Southern California, as bearing on the origin of the Red Man in America." He called attention to the facts relating to the antiquity of man on the Pacific coast, and to the importance of the discovery in California of human remains and of the works of man in the gravel, under beds of volcanic material, where they were associated with the remains of extinct animals, and to the necessity of looking to this early race for much that it seems otherwise impossible to account. He thought that what is called the "Eskimo element," in the physical characters and arts of the southern Californians, was very likely due to the impress from a primitive American stock, which is probably to be found now in its purest continuation in the Innuit. In this connection he dwelt upon the probability of more than one type of man. In following out this argument he called attention to the distinctive characters in different tribes of Indians on the Pacific coast, and stated his belief that they had resulted from an admixture of the descendants of different stocks. The Californians of 300 years ago, he thought, were the result of development by contact of tribe with tribe through an immense period of time, and that the primitive race of America, which

was as likely autochthonous as of Asiatic origin, had stamped its impress on the people of California The early men of America he believed were dolichocephali, and the short-headed people he thought were made up of a succession of intrusive tribes in a higher stage of development, which in time overran the greater part of both North and South America, conquering and absorbing the long-headed people, or driving them to the least desirable parts of the continent. He thought that the evidence was conclusive that California had been the meeting ground of several distinct branches of the widely-spread Mongoloid stock, for in no other way could he account for the remarkable commingling of customs, arts and languages, and the formation of the large number of tribes that existed in both Upper and Lower California when first known to the Spaniards Mr Putnam then gave a review of the arts of the Californians and the physical characters and customs of the people, showing that, notwithstanding the absence of pottery, the tribes, when first known, had passed through the several stages of savagery and had reached the lower status of barbarism of the "ethnical periods" given by Morgan.

PROF. SCHÄFER's course of eleven lectures on the Blood at the Royal Institution will begin on the 25th instant instead of the 18th. Mr. Francis Hueffer's course of four lectures on the Troubadours will begin on the 27th instant instead of the 20th, and Prof Sidney Colvin's course of four lectures on the Amazons will begin on the 29th instant instead of the 22nd

PART 2 of vol vii of the "Natural History Transactions of Northumberland, Durham, and Newcastle-on-Tyne" has just been issued (Williams and Norgate). The part contains an interesting memoir of the late Mr W C Hewitson, F L S., by Dr. Embleton, accompanied by a good photograph There is a long paper by Mr. Hugh Miller on Tynedale Escarpments, their pre-glacial, glacial, and post-glacial features.

HERR E REYER has published a little pamphlet containing some interesting notes on the history of tin

AT the meeting of the Eastbourne Natural History Society of December 17, 1886, Mr Charles Foran read "Notes on some of the Beetles of the Cuckmere District"

THE Municipal Council of Paris has given authority to the Lontin Company to light the Place du Carrousel with electricity. A contract has been signed by the Lyons and Mediterranean Company for illuminating, by the Lontin light, all the principal railway stations on their system Experiments have been tried at Marseilles and have been carried out successfully.

FROM January 1 *L'Electricité* and *La Lumière Electrique*, two French electrical papers, will appear every week instead of every fortnight.

THE German Society of Eastern Asia, having its headquarters at Yokohama, has sent us the last four parts of its *Mittheilungen*. This Society is evidently doing a very useful work in collecting information on a great variety of subjects connected especially with Japan. The parts sent us contain papers on such subjects as Japanese proverbs, diseases, songs, population statistics, mining, cremation, the "Go" game, coins, and the chalk formation of Yedo. Asher and Co. of Berlin are the European agents of the Society

WE find in the *Journal de Genève* the following figures as to the very warm winter which is experienced during this year on the shores of Lake Leman, as compared with the unusually cold winter of the year passed. In December, 1879, the maximum daily temperature at Geneva was only five times above zero, and the average was +6°·4 Cels., whilst the average of the maximum temperatures of the remaining twenty-six days was -4° 5 Cels. As to the minima they were only twice above zero, and their average was +2°·9, whilst the average of the remaining twenty-nine minima was -9° 7 In December, 1880, the thermometer was only six times below the melting-point, and the average of the cold minima was -0°·7, whilst the average of the minima for the other twenty-five days was +3° 8 As to the maxima they fell below zero, and their average is as high as +9°·1 The greatest cold experienced during December, 1879, was -15° Cels., and only -1° 5 in 1880, the warmest temperature observed during December, 1879, was +8° 9, and +13° Cels in 1880.

A TEA plantation was established last year by Count d'Amigo upon his estates, situated near Messina The tea plant is said to thrive perfectly well there, and its leaves are said to be in nowise inferior to those of the Chinese plant In order to dry them in a rational manner and to prepare them for export as well as for home consumption, a Chinese expert is to become the manager of the Messina plantations.

THE Wissenschaftliche Centralverein at Berlin held its annual general meeting on December 13, 1880 The secretary, Dr Max Hirsch, in his yearly report stated that the principal efforts of the Society had been directed towards furthering the progress of the Humboldt Academy, which was founded by the Society some two years ago, and which since that time shows a total of ninety-two courses of lectures, which were delivered before 3366 students and a still larger number of "hospitanten," *i e* casual students. Apart from these lecture-courses the Society has for this winter arranged for a number of single lectures by eminent men of science The establishment of a large reading-room is also planned.

A YOUNG Men's Society for Home Study has been started in the United States The aim of the Society is to guide and encourage young men desirous of systematic study and reading at home by opening to them, by means of correspondence, systematic courses in various subjects Courses of reading and plans of work are arranged, from which men may select one or more, according to their taste and leisure, and aid is given them, from time to time, through directions and advice The courses offered by the Society at present (more may be added as the demand for them becomes known) are: Course 1. American and English History Course 2 English Literature Course 3 German Literature. Course 4 Natural Science: Sec. 1, Botany, Sec 2, Zoology, Sec. 3, Geology. Course 5. Mathematics. Mr. Samuel H. Scudder is head of the Natural Science Department.

THE simplest post-office in the world is in Magellan Straits, and has been established there for some years past It consists of a small cask, which is chained to the rock of the extreme cape in the straits, opposite Tierra del Fuego Each passing ship sends a boat to open the cask and to take letters out and place others into it The post-office is self-acting therefore; it is under the protection of the navies of all nations, and up to the present there is not one case to report in which any abuse of the privileges it affords has taken place

OUR ASTRONOMICAL COLUMN

WINNECKE'S COMET.—Reference has been already made in this column to the very unfavourable circumstances attending the actual return to perihelion of the short-period comet of Winnecke, and so far there is no intimation of its having been detected even with telescopes of the greatest optical capacity. Indeed, as will be seen from Prof. Oppolzer's communication in the *Astron Nach* No 2326, though he gave an accurately-computed ephemeris extending to January 24, he considered the chance of perceiving the comet a very remote one The perihelion passage took place on December 4, and the intensity of light is now very small, not greater than half that at the date of the last observation in 1858. The comet sets less than 1h. 45m.

after the sun. The later positions in Prof. Oppolzer's ephemeris are as follows —

12h. Berlin M.T

	R.A. h m s	N P D ° ′	Log distance from Earth
January 16	21 29 12	109 41·4	0 2836
18	21 38 18	109 9 7	0 2875
20	21 47 12	108 36 9	0 2916
22	21 55 54	108 3 2	0 2959
24	22 4 23	107 28·6	0 3002

SWIFT'S COMET.—Mr. Common, with his reflector of three feet aperture at Ealing, has observed this comet for position as late as January 5, when it was not yet considered the *extremum visible* in the instrument. Accurate observations were made by Mr. Lewis Boss at the Dudley Observatory, Albany, U.S., on October 11, the night after discovery, so that there will be a good extent of observation upon which to determine the orbit at this appearance.

MINIMA OF ALGOL—The following epochs of geocentric minima of Algol are deduced from Prof. Schonfeld's elements That very sensible perturbations have taken place during the last few years is shown by a comparison of these elements with the observations of Prof Julius Schmidt of Athens; thus the mean errors since 1875 are, for 1875·76 − 4 8m., 1876 76 + 19·4m, 1877 73 + 40 8m.; 1878 78 + 21 3m The star is well deserving of attention during the present year

	G M T. h m		G M T h m
January 21	18 20	February 13	16 54
24	15 9	16	13 43
27	11 58	19	10 32
30	8 48	22	7 22
February 2	5 37		

CERASKI'S VARIABLE IN CEPHEUS—A series of minima of this star visible in Europe commences about January 13, continuing until May. The period may be taken = 2·492913d or 2d 11h 49 795m, and if we reckon from the second minimum completely observed by Prof Schmidt on October 18, 1880, we shall find a minimum on January 18 at 17h. 41m. G M. T, and successive visible epochs may be inferred by adding 4d 23h 39 59m.

ELONGATIONS OF MIMAS—According to the elements previously adopted in this column for indicating approximately the times of greatest elongations of this very difficult object, the satellite would be at the western extremity of its apparent orbit at the following Greenwich times —

	h m		h m.
January 19	11 5	January 22	6 56
20	9 42	23	5 33
21	8 19		

The elements upon which Prof. Newcomb's manuscript tables adopted in the *American Ephemeris* for 1882 and 1883 are founded appear to give the times of the elongations later by some forty minutes.

THE ACADEMY OF SCIENCES, PARIS—The recent election of Dr. Warren De La Rue as Correspondent of the Academy of Sciences of the Institute of France, Section of Astronomy, in place of the late Sir Thomas Maclear, nearly completes the usual number of correspondents in this section, upon which several vacancies had existed for some time The roll is now as follows, taking the names in alphabetical order—Adams (Cambridge), Cayley (Cambridge), De La Rue (London), Gyldén (Stockholm), Hall (Washington), Hind (London), Huggins (London), Lockyer (London), Newcomb (Washington), Oppolzer (Vienna), Plantamour (Geneva), Roche (Montpellier), Schiaparelli (Milan), Stephan (Marseilles), and Struve (Pulkova). The Astronomer-Royal is one of the eight Foreign Associates of the Academy

GEOGRAPHICAL NOTES

WE are glad to learn that the rumour of the murder of Herr Hildebrandt in Madagascar is unfounded.

THE first number of the memoirs (*Zapiski*) of the West Siberian Branch of the Russian Geographical Society contains valuable papers by M. Kostroff on witches in the Government Tomsk, by M. Grigorovsky, on the peasantry in the Narym district; by M Pyevtzoff, on his journey through Djoungaria, with a map, and by M. Balkashin, on trade *viâ* the Ob River with Europe during the years 1877 and 1878

AT one of its recent meetings the Russian Geographical Society discussed the proposal of Mr Fleming, transmitted to the Society by the Governor-General of Canada, as to the adoption of a universal time and of a universal first meridian. As to the suggestion to have a cosmopolitan noon at the same moment over the surface of our globe, the Society thinks that it would meet with a mass of difficulties as to its application in daily life, but the advantages which a universal time would afford being very great, the Society expresses the wish that the whole question be earnestly discussed and studied by learned societies. As to the first meridian, the Society, which already discussed the question in 1870, maintains its former resolution, namely, that the meridian of Greenwich, or at least that of Behring Strait, 180° distant from that of Greenwich, should be accepted by the whole civilised world as a first meridian.

WE have received the annual reports for 1879 of the Siberian, Orenburg, and Caucasian branches of the Russian Geographical Society, which has had the happy idea to publish all the reports together in one volume, thus rendering accessible for the general reader who knows Russian this most valuable geographical information, formerly disseminated in local publications The oldest of these branches, the East Siberian, has endured heavy losses during the great fire at Irkoutsk. Its rich zoological, botanical, geological, and ethnographical collections were all destroyed by fire. the beautiful head of a *Rhinoceros tichorhinus*, just received from Verkhoyansk, the rare collection of samples of gold from all the gold-mines of Eastern Siberia, palæontological collections not yet described, and so on, as well as the 10,230 volumes of its rich library, and collections of old records, were all destroyed by fire Several scientific bodies, Russian and foreign, have already sent their publications and duplicates from their libraries, so that the museum and library already are in way of reconstitution

THE third volume of the "Rajputana Gazetteer" has just been issued from the Government press at Simla. The various sections into which it is divided are contributed by Capt C E. Yate, Major C A Baylay, and Major P W. Powlett, and treat of general topography, history, population, trade, towns, &c Mr J F. Baness, the chief draughtsman in the geographical and drawing branch of the Survey of India, has in the press at Calcutta a work entitled "Index Geographicus Indicus" It will be published in one volume, with eight coloured maps, and will comprise a list, alphabetically arranged, of the principal places in our Indian Empire, accompanied by much statistical, political, and descriptive information.

A SERIES of papers is commenced in last week's issue of *Les Missions Catholiques*, on the manners, customs, and religion of the races of the Caucasus

The new number of the *Bulletin* of the Commercial Geographical Society of Bordeaux contains a useful paper on Japan, by M E Labrone

THE Palestine Exploration Society have decided to undertake the exploration of Palestine east of the Jordan.

OBSERVATIONS ON ANTS, BEES, AND WASPS[1]

Power of Communication by something approaching to Language.

IN my previous papers many experiments have been recorded, in which I have endeavoured to throw some light on the power of communication possessed by ants. It is unquestionable that if an ant or a bee discovers a store of food her comrades soon flock to the treasures, although, as I have shown, this is by no means always the case But it may be argued that this fact taken alone does not prove any power of communication at all. An ant observing a friend bringing food home might infer, without being told, that by accompanying the friend on the return journey she might also participate in the good things. I have endeavoured to meet this argument in my third paper (*Linn Journ.* vol. xii. p. 466) by showing that there was a marked

[1] By Sir John Lubbock Bart, M P, F R S, F L S, D C L, LL D, Vice-Chancellor of the University of London Read at the Linnean Society, June 17 Abstract

difference in the result, if on experimenting with two ants one had access to a large treasure, the other only to a small one

It also occurred to me that some light would be thrown on the question by compelling the ant who found the treasure to return empty handed. If she took nothing home and yet others returned with her, this must be by some communication having passed. It would be a case in which precept was better than example.

I selected therefore a specimen of *Atta testaceo pilosa*, belonging to a nest which I had brought back with me from Algeria. She was out hunting about six feet from home, and I placed before her a large dead bluebottle fly, which she at once began to drag to the nest. I then pinned the fly to a piece of cork, in a small box, so that no ant could see the fly until she had climbed up the side of the box The ant struggled, of course in vain, to move the fly. She pulled first in one direction and then in another, but, finding her efforts fruitless, she at length started off back to the nest empty handed. At this time there were no ants coming out of the nest. Probably there were some few others out hunting, but for at least a quarter of an hour no ant had left the nest. My ant entered the nest but did not remain there, in less than a minute she emerged accompanied by seven friends I never saw so many come out of that nest together before In her excitement the first ant soon distanced her companions, who took the matter with much *sang froid*, and had all the appearance of having come out reluctantly, or as if they had been asleep and were only half awake The first ant ran on ahead, going straight to the fly. The others followed slowly and with many meanderings, so slowly, indeed, that for twenty minutes the first ant was alone at the fly, trying in every way to move it. Finding this still impossible, she again returned to the nest, not chancing to meet any of her friends by the way. Again she emerged in less than a minute with eight friends, and hurried on to the fly. They were even less energetic than the first party, and when they found they had lost sight of their guide they one and all returned to the nest. In the meantime several of the first detachment had found the fly, and one of them succeeded in detaching a leg, with which she returned in triumph to the nest, coming out again directly with four or five companions. These latter, with one exception, soon gave up the chase and returned to the nest I do not think so much of this last case, because as the ant carried in a substantial piece of booty in the shape of the fly's leg, it is not surprising that her friends should some of them accompany her on her return; but surely the other two cases indicate a distinct power of communication.

Lest however it should be supposed that the result was accidental, I determined to try it again Accordingly on the following day I put another large dead fly before an ant belonging to the same nest, pinning it to a piece of cork as before After trying in vain for ten minutes to move the fly, my ant started off home. At that time I could only see two other ants of that species outside the nest Yet in a few seconds, considerably less than a minute, she emerged with no less than twelve friends As in the previous case, she ran on ahead, and they followed very slowly and by no means directly, taking in fact nearly half an hour to reach the fly. The first ant, after vainly labouring for about a quarter of an hour to move the fly, started off again to the nest. Meeting one of her friends on the way she talked with her a little, then continued towards the nest, but after going about a foot, changed her mind, and returned with her friend to the fly After some minutes, during which two or three other ants came up, one of them detached a leg, which she carried off to the nest, coming out again almost immediately with six friends, one of whom, curiously enough, seemed to lead the way, tracing it, I presume, by scent. I then removed the pin, and they carried off the fly in triumph

These and other experiments certainly seem to indicate the possession by ants of something approaching to language. It is impossible to doubt that the friends were brought out by the first ant, and as she returned empty-handed to the nest, the others cannot have been induced to follow her merely by observing her proceedings. I conclude, therefore, that they possess the power of requesting their friends to come and help them.

Recognition of Relations.—In my last paper (*Linn. Journ.* vol. xiv. p 611) I recorded some experiments made with pupæ, in order if possible to determine how ants recognised their nest companions. The general result was that pupæ tended by strangers of the same species, and then after they had arrived at maturity put into the nest from which these strangers had been taken, were invariably treated as interlopers and attacked. On the other hand, if they were tended by ants from their own nest, and then after arriving at maturity put back in their own nest, they were invariably recognised as friends, and lastly, if as pupæ they were tended by strangers, but then after arriving at maturity put back in their own nest, they were generally received as friends. In all these experiments, however, the ants were taken from the nest as pupæ, and though I did not think the fact that they had passed their larval existence in the nest could affect the problem, still it might do so. I determined therefore to separate a nest before the young were born, or even the eggs laid, and then ascertain the result. Accordingly I took one of my nests, which I began watching on September 13, 1878, and which contained two queens, and on February 8, 1879, divided it into halves, which I will call A and B, so that there were approximately the same number of ants with a queen in each division. At this season, of course, the nest contained neither young nor even eggs. During April both queens began to lay eggs On July 20 I took a number of pupæ from each division and placed each lot in a separate glass, with two ants from the same division. On August 30 I took four ants from the pupæ bred in B, and one from those in A (which were not quite so forward), and after marking them as usual with paint, put the B ants into nest A, and the A ant into nest B They were received amicably and soon cleaned. Two, indeed, were once attacked for a few moments, but soon released On the other hand, I put two strangers into nest A, but they were at once killed. For facility of observation I placed each nest in a closed box. On the 31st I carefully examined the nests and also the boxes in which I had placed them I could only distinguish one of the marked ants, but there were no dead ants either in the nests or boxes, except the two strangers

Some further experiments led to similar results.

These observations seem to me conclusive as far as they go, and they are very surprising. In my experiments of last year, though the results were similar, still the ants experimented with had been brought up in the nest, and were only removed after they had become pupæ It might therefore be argued that the ants having nursed them as larvæ, recognised them when they came to maturity, and though this would certainly be in the highest degree improbable, it could not be said to be impossible. In the present case, however, the old ants had absolutely never seen the young ones until the moment when, some days after arriving at maturity, they were introduced into the nest, and yet in all ten cases they were undoubtedly recognised as belonging to the community

It seems to me therefore to be established by these experiments that the recognition of ants is not personal and individual, that their harmony is not due to the fact that each ant is individually acquainted with every other member of the community.

At the same time the fact that they recognise their friends even when intoxicated, and that they know the young born in their own nest even when they have been brought out of the chrysalis by strangers, seems to indicate that the recognition is not effected by means of any sign or password.

Worker breeding.—In my last paper I brought forward some strong evidence tending to show that when workers laid eggs they always produced males. This is, however, a physiological fact of so much interest that I have carefully watched my nests this year also, to see what further light they would throw on the subject. In six of those which contained no queen eggs were produced, which of course must necessarily have been laid by workers belonging to *Lasius niger*, *Formica cinerea*, *Formica fusca* and *Polyergus rufescens*.

The result was that in five of these nests males have been produced, and in not a single case has a worker laid eggs which have produced a female, either a queen or a worker. Perhaps I ought to add that workers are abundantly produced in those of my nests which possess a queen. Again, as in previous years, so this season again, while great numbers of workers and males have come to maturity in my nests, not a single queen has been produced. We have, I think, therefore, strong reason for concluding that, as in the case of bees, so also in ants, some special food is required to develop the female embryo into a queen.

As to Hearing and Experiments with Telephone.—In order to ascertain if possible whether ants made any sounds which were audible to one another, I thought I would try the telephone. Accordingly I looked for two ants' nests (*Lasius niger*) not far from one another, and then, after disturbing one of them, had a telephone held just over it. I then held the second telephone close over the other nest, each telephone being

perhaps one to two inches above the ground. If the disturbed ants made any sound which was transmitted by the telephone, the ants in the other nest ought to have been thrown into confusion. I could not, however, perceive that it made the slightest difference to them. I tried the experiment three or four times, always with the same result. I then put some syrup near a nest of *L. niger*, and when several hundred ants were feeding on the syrup I blew on the nest, which always disturbs them very much. They came out in large numbers and ran about in great excitement. I then held one end of the telephone over the nest, the other over the feeding ants, who, however, took not the slightest notice. I cannot, however, look on these experiments as at all conclusive, because it may well be that the plate of the telephone is too stiff to be set in vibration by any sounds which ants could produce.

On the Treatment of Aphides.—Our countryman Gould, whose excellent little work on ants[1] has hardly received the attention it deserves, observes that "the queen ant [he is speaking of *Lasius flavus*] lays three different sorts of eggs: the slave, female, and neutral. The two first are deposited in the spring, the last in July and part of August; or, if the summer be extremely favourable, perhaps a little sooner. The female eggs are covered with a thin black membrane, are oblong, and about the sixteenth or seventeenth part of an inch in length. The male eggs are of a more brown complexion, and usually laid in March."

Here however our worthy countryman fell into an error, the eggs which he thus describes not being those of ants, but, as Huber correctly observed, of Aphides.[2] The error is the more pardonable, because the ants treat these eggs exactly as if they were their own, guarding and tending them with the utmost care. I first met with them in February, 1876, and was much astonished, not being at that time aware of Huber's observations. I found, as Huber had done before me, that the ants took the greatest care of these eggs, carrying them off to the lower chambers with the utmost haste when the nest was disturbed. I brought some home with me and put them near one of my own nests, when the ants carried them inside. That year I was unable to carry my observations further. In 1877 I again procured some of the same eggs, and offered them to my ants, who carried them into the nest, and in the course of March I had the satisfaction of seeing them hatch into young Aphides. M. Huber however does not think these are mere ordinary eggs. On the contrary he agrees with Bonnet "that the insect, in a state nearly perfect, quits the body of its mother in that covering which shelters it from the cold in winter, and that it is not, as other germs are, in the egg surrounded by food, by means of which it is developed and supported. It is nothing more than an asylum of which the Aphides born at another season have no need; it is on this account some are produced naked, others enveloped in a covering. The mothers are not then truly oviparous, since their young are almost as perfect as they ever will be, in the asylum in which Nature has placed them at their birth."[3]

This is, I think, a mistake. This is not the opportunity to describe the anatomy of the Aphis; but I may observe that I have examined the female, and find these eggs to arise in the manner so well described by Huxley in our *Transactions*,[4] and which I have also myself observed in other Aphides and in allied genera.[5] Moreover I have opened the eggs themselves, and have also examined sections, and have satisfied myself that they are true eggs containing ordinary yelk. If examined while still in the ovary the germ-vesicle presents the usual appearance, but in laid eggs I was unable to detect it. So far from the young insect being "nearly perfect," and merely enveloped in a protective membrane, no limbs or internal organs are present. These bodies are indeed real ova, or pseudova, and the young Aphis does not develop in them until shortly before they are hatched.

When my eggs hatched I naturally thought that the Aphides belonged to one of the species usually found on the roots of plants in the nests of *Lasius flavus*. To my surprise, however, the young creatures made the best of their way out of the nest, and indeed were sometimes brought out by the ants themselves. In vain I tried them with roots of grass, &c.; they wandered uneasily about, and eventually died. Moreover they did not in any way resemble the subterranean species. In 1878 I again attempted to rear these young Aphides; but though I hatched a great many eggs, I did not succeed. This year however I have been more fortunate. The eggs commenced to hatch the first week in March. Near one of my nests of *Lasius flavus*, in which I had placed some of the eggs in question, was a glass containing living specimens of several species of plant commonly found on or around ants' nests. To this some of the young Aphides were brought by the ants. Shortly afterwards I observed on a plant of daisy, in the axils of the leaves, some small Aphides very much resembling those from my nest, though we had not actually traced them continuously. They seemed thriving, and remained stationary on the daisy. Moreover, whether they had sprung from the black eggs or not, the ants evidently valued them, for they built up a wall of earth round and over them. So things remained throughout the summer; but on October 9 I found that the Aphides had laid some eggs exactly resembling those found in the ants' nests; and on examining daisy-plants from outside I found on many of them similar Aphides, and more or less of the same eggs.

I confess these observations surprised me very much. The statements of Huber have not indeed attracted so much notice as many of the other interesting facts which he has recorded; because if Aphides are kept by ants in their nests, it seems only natural that their eggs should also occur. The above case however is much more remarkable. Here are Aphides, not living in the ants' nests, but outside, on the leaf-stalks of plants. The eggs are laid early in October on the food-plant of the insect. They are of no direct use to the ants, yet they are not left where they are laid, where they would be exposed to the severity of the weather and to innumerable dangers, but brought into their nests by the ants, and tended by them with the utmost care through the long winter months until the following March, when the young ones are brought out and again placed on the young shoots of the daisy. This seems to me a most remarkable case of prudence. Our ants may not perhaps lay up food for the winter, but they do more, for they keep during six months the eggs which will enable them to procure food during the following summer.

No doubt the fact that our European ants do not generally store up food in the usual way is greatly due to the nature of their food. They live, as we know, partly on insects and other small animals which cannot be kept fresh; and they have not learnt the art of building vessels for their honey, probably because they are not kept in cells like those of the honey-bee, and their pupæ do not construct firm cocoons like those of the humble-bee.

Moreover it is the less necessary for them to do so, because if they obtain access to any unusual store of honey, that which they swallow is only digested by degrees and as it is required; so that, as the camel does with water, they carry about with them in such cases a supply of food which may last them a considerable time. They have moreover, as we know, the power of regurgitating this food at any time, and so supplying the larvæ or less fortunate friends. Even in our English ants the quantity of food which can be thus stored up is considerable in proportion to the size of the insect; and if we watch, for instance, the little brown garden-ant (*Lasius niger*) ascending a tree to milk their Aphides, and compare them with those returning full of honey, we shall see a marked difference in size.

We have, indeed, no reason to suppose that in our English ants any particular individuals are specially told off to serve as receptacles of food. W. Wesmael, however, has described[1] a remarkable genus (*Myrmecocystus mexicanus*), brought by M. de Normann from Mexico, in which certain individuals in each nest serve as animated honey-pots. To them the foragers bring their supplies, and their whole duty seems to be to receive the honey, retain it, and redistribute it when required. Their abdomen becomes enormously distended, the intersegmental membranes being so much extended that the chitinous segments which alone are visible externally in ordinary ants seem like small brown transverse bars. The account of these most curious insects given by MM. de Normann and Wesmael has been fully confirmed by subsequent observers; as, for instance, by Lucas,[2] Saunders,[3] Edwards,[4] Blake,[5] Loew,[6] and McCook.

[1] "An Account of English Ants." By the Rev. W. Gould, 1747, p. 36.
[2] My lamented friend Mr. Smith also observed these eggs (*Entom. Annual*, 1871). He did not however identify the species to which they belonged.
[3] "The Natural History of Ants." By M. P. Huber, 1820, p. 246.
[4] *Trans.* Linn. Soc., vol. xxii. 1859.
[5] *Philosophical Transactions*, 1859.

[1] *Bull. de l'Acad. des Sci. de Bruxelles.*
[2] *Ann. Soc. Ent. de France*, v. p. 111.
[3] *Canadian Entomologist*, vol. vii. p. 12.
[4] *Proc.* Californian Academy, 1873.
[5] *Ibid.* 1874.
[6] *American Nat.* viii. 1874.

On one very important point, however, M Wesmael was in error; he states that the abdomen of these abnormal individuals "ne contient aucun organe; ou plutôt, il n'est lui-même qu'un vaste sac stomacal." Blake even asserts that "the intestine of the insect is not continued beyond the thorax," which must surely be a misprint; and also that there is no connection "between the intestine and the cloaca"! These statements, however, are entirely erroneous; and, as M. Forel has shown, the abdomen does really contain the usual organs, which, however, are very easily overlooked by the side of the gigantic stomach.

I have now the honour of exhibiting to the Society a second species of ant, which has been sent me by Mr Waller, in which a similar habit has been evolved and a similar modification has been produced. The two species, however, are very distinct, and the former is a native of Mexico, while the present comes from Adelaide in Australia. The two species, therefore, cannot be descended one from the other; and it seems inevitable that the modification has originated independently in the two species.

It is interesting that, although these specimens apparently never leave the nest, and have little use therefore for legs, mandibles, &c., the modifications which they have undergone seem almost confined to the abdominal portion of the digestive organs. The head and thorax, antennæ, jaws, legs, &c, differ but little from those of ordinary ants

CAMPONOTUS INFLATUS, n. sp

Operaria. Long 15 mill Nigra, tarsis pallidioribus, subtiliter coriacea, setis cinereo testaceis sparsis, antennis tibiisque haud pilosis, tarsis infra hirsutis; mandibulis punctatis, hirsutis, sexdentatis; clypeo non carinato, antice integro; petioli squama modice incrassata, antice convexa, postice plana emarginata

Hab. Australian.

The colour is black, the feet being somewhat paler The body is sparsely covered with stiff cinereo testaceous hairs, especially on the lower and anterior part of the head, the mandibles, and the posterior edge of the thorax. The head and thorax are finely coriaceous.

The antennæ are of moderate length, twelve-jointed, the scape about one-third as long as the terminal portion and somewhat bent At the apex of the scape are a few short spines, bifurcated at the point. At the apex of each of the succeeding segments are a few much less conspicuous spines, which decrease in size from the basal segments outwards. The antenna is also thickly clothed with short hairs, and especially towards the apex with leaf-shaped sense-hairs The clypeus is rounded, with a slightly developed median lobe and a row of stiff hairs round the anterior border, it is not carinated The mandibles have six teeth, those on one side being rather more developed and more pointed than those on the other. They decrease pretty regularly from the outside inwards. The maxillæ are formed on the usual type The maxillary palpi are six-jointed, the third segment being but slightly longer than the second, fourth, or fifth, while in *Myrmecocystus* the third and fourth are greatly elongated. The segments of the palpi have on the inner side a number of curious curved blunt hairs besides the usual shorter ones. The labial palpi are four-jointed. The eyes are elliptical and of moderate size The ocelli are not developed

The thorax is arched, broadest in front, without any marked incision between the meso- and metanotum, the mesonotum itself is, when seen from above, very broadly oval, almost circular, rather broader in front and somewhat flattened behind The legs are of moderate length, the hinder ones somewhat the longest The scale or knot is heart-shaped, flat behind, slightly arched in front, and with a few stiff, slightly diverging hairs at the upper angles. The length is about two thirds of an inch

ON THE THERMIC AND OPTIC BEHAVIOUR OF GASES UNDER THE INFLUENCE OF THE ELECTRIC DISCHARGE[1]

PROF. E. WIEDEMANN has undertaken an exact calorimetric investigation of the electric discharge through gases, and in spite of the serious difficulties which he had to encounter, he has already obtained valuable and important results. As a source of electricity, Topler's machine was used; but we must refer to the original paper for all details of experimentation.

Three series of observations were made. In the first the total heat generated in a given time in the whole vacuum tube was measured In the second series the capillary part only was examined, and in the third the thermal behaviour of the regions in the neighbourhood of the electrodes was investigated. The result of the first series is summed up as follows:—With decreasing pressure the total quantity of heat generated at first decreases, reaches a minimum, and then increases again. In hydrogen the amount of heat generated is smaller than in atmospheric air.

A smaller amount of heat developed corresponds to a larger number of discharges in a given time, and hence to a smaller potential at the moment the discharge begins to pass. The results of Prof Wiedemann are therefore, as he points out, in accordance with those of Messrs De La Rue and Hugo Muller, who found that the difference of potential necessary to cause a discharge passes through a minimum as the pressure decreases.

Somewhat more complicated results were obtained when an air-break was introduced into the circuit In that case the air-break determines the difference of potential necessary to produce a discharge; but if the whole quantity of electricity would pass suddenly when that potential has been reached, and before it has had time to sink, the amount of heat generated would be independent of the pressure in the vacuum tube. This however is not the case, but the result is intermediate between that obtained when no air break exists, and that which would be obtained on the above supposition

The following results were obtained in the experiments in which the capillary part of a vacuum tube only was introduced into the calorimeter —

1. The heating effect in capillary tubes at pressures above 1 mm is almost independent of the quantity of electricity passing with each discharge, and nearly proportional to the total amount of electricity which passes

2 The heating effect is almost the same whether the positive or negative electrode of the tube is connected with the machine (the other electrode being connected with the earth), although the number of discharges passing in a given time is different.

3 With decreasing pressure the heat generated decreases very rapidly without passing through a minimum

4 The heating effect is independent of the shape of the electrodes. Some results obtained by Prof G Wiedemann, who had found that in tubes of different widths the same amount of heat is generated by the same current, were confirmed.

Calorimetric measurements made near the electrodes showed

1 The heating effect near the positive electrode decreases with decreasing pressure rapidly At very low pressures a small increase is sometimes observed.

2. The heating effect near the negative electrode decreases first with decreasing pressure, and then increases rapidly

The heating effect near the positive electrode shows some anomalies when an air break is introduced, the amount of heat generated being considerably increased.

Some measurements were reduced to an absolute scale, and showed that the total amount of heat generated is very large Taking account of the number of discharges, and assuming that after each discharge the gas returns to its original state, the temperature in the capillary part of the tube must have been about 2,000° C at 15 mm pressure, and about 1,100° C at 5 mm pressure If the width of the tube was increased ten times, the temperature would only be about 100° C., and this confirms the result obtained by Prof. Wiedemann in a former investigation, that gases may become luminous under the influence of the electric discharge at a comparatively low temperature.

In another part of the paper Prof Wiedemann treats of a very important problem. When his tubes were filled with hydrogen, and an air-break was introduced in the circuit, the spectrum of the luminous gas changed suddenly at a given point According to a now generally accepted hypothesis this change of spectrum is always accompanied by a change in the molecular constitution of the gas, and it is to be expected therefore that heat is either absorbed or given out by a gas when its spectrum changes. This heat Prof Wiedemann has endeavoured to measure. Let us imagine, for instance, that the current has to do the work of decomposing the molecules of a gas The moment the discharge has passed, recomposition will take place, and the heat then generated was measured by Prof. Wiedemann. Some of the suppositions on which the calculations are based might require further investigation, but the assumptions made are supported, and to a certain extent proved by the fact that the heat necessary to change the band-spectrum into the line-spectrum was found to be *independent of the pressure and cross-section of the tube.* It is

[1] By Eilhard Wiedemann (*Wied. Ann*, x. p. 202.)

clear that Prof. Wiedemann's line of investigation would afford an absolute proof that the changes of spectra are really due to the causes to which they are now hypothetically referred by the majority of observers It is however rather unfortunate that in the particular case under discussion the chemical origin of the band-spectrum has not been settled to the general satisfaction of all observers A good many of them believe the spectrum to be due to a hydrocarbon, and in that case Prof Wiedemann would simply have measured the heat of combustion of hydrogen and carbon. No doubt Prof Wiedemann will extend his measurements to other gases for which the spectroscopic difficulties have been more satisfactorily settled

Prof. Wiedemann has also investigated some phenomena in vacuum tubes, which have also been partly discussed by other observers. Thus under certain conditions more exactly investigated by Messrs. Spottiswoode and Moulton, it is known that a conductor of electricity brought near a vacuum tube will deflect the discharge Prof. Wiedemann finds, as had already been previously noticed by Mr Goldstein, that the point touched by the conductor behaves like a negative electrode It is known that as a rule the rays proceeding from a negative electrode are propagated in straight lines, and do not turn round a corner An experiment however is mentioned by Prof Wiedemann, in which an exception to this rule seems to take place, but Prof Wiedemann himself suggests that secondary phenomena might have influenced the result Perhaps an explanation is to be found in the fact proved by Mr Goldstein, that when two tubes of different width are fused together the point of junction behaves like a negative electrode

Some experiments were made to show that the rays producing the phosphorescence can traverse the positive discharge; also to prove that when the pressure is very small the shape of the electrodes has a great influence on the number of discharges and on the other phenomena attending them

Prof. Wiedemann winds up with some interesting speculations on the nature of the discharge of electricity through gases, but it was our object to give an account only of his experimental results A theoretical discussion would lead us too far, as we should have to take account of other writings which have lately appeared. We may return to this part of the subject on another occasion. It is evident from the account we have given that the calorimetric methods employed by Prof Wiedemann have enabled him to take a very material step towards the elucidation of a difficult problem, and we may hope for another series of his valuable measurements. ARTHUR SCHUSTER

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

EDINBURGH —The Baxter Physical Science Scholarship of 116*l*, conferred by the University of Edinburgh on the most eminent B Sc who has taken his degree during the present or the preceding year, has been awarded to Mr D Orme Masson, lecturer on Chemistry at University College, Bristol, who is prevented from accepting it in consequence of holding his present appointment

THE system of Fellowships in the Johns Hopkins University is of considerable interest. Twenty Fellowships, each yielding five hundred dollars, are annually open to competition in this University. The system of Fellowships was instituted for the purpose of affording to young men of talent from any place an opportunity to continue their studies in the Johns Hopkins University, while looking forward to positions as professors, teachers, and investigators, or to other literary and scientific vocations The appointments have not been made as rewards for good work already done, but as aids and incentives to good work in the future; in other words, the Fellowships are not so much honours and prizes bestowed for past achievements, as helps to further progress, and stepping-stones to honourable intellectual careers. They have not been offered to those who are definitely looking forward to the practice of either of the three learned professions (though such persons have not been formally excluded from the competition), but have been bestowed almost exclusively on young men desirous of becoming teachers of science and literature, or determined to devote their lives to special branches of learning which lie outside of the ordinary studies of the lawyer, the physician, and the minister. Every candidate is expected to submit his college diploma or other certificate of proficiency from the institution where he has been taught, with recommendations from those who are qualified to speak of his character and attainments But this is only introductory. He must also submit, orally or in writing, such evidence of his past success in study and of his plans for the future, together with such examples of his literary or scientific work as will enable the professors to judge of his fitness for the post The examination is indeed in a certain sense competitive, but not with uniform tests, nor by formal questions and answers submitted to the candidates First, the head of a given department considers, with such counsel as he may command, the applicant's record The professors then collectively deliberate on the nominations made by individual members of their body The list upon which they agree, with the reasons for it, is finally submitted by the president of the University to the Executive Committee, and by them to the trustees for final registration and appointment By all these precautions the highest results which were anticipated have been secured A company of most promising students has been brought together, and their ability as teachers and scholars has been recognised by the calls they have received to permanent and attractive posts in different parts of the country

A SPECIAL feature of Russian universities is that the students mostly belong to the poorer classes, and that they earn the means of existence by teaching or by translating foreign works for the monthly reviews Thus, at the same time as the foundation stone of the Siberian University was laid at Tomsk, a subscription was raised for the erection of a building in which gratuitous lodgings might be given to students The well-known explorer of Western Siberia, M Yadrintzeff, immediately after his return from his last journey, delivered a series of lectures on the scenery of Altay, to raise funds for that purpose.

THE new university at Tomsk will be most liberally endowed Up to the day of laying the foundation-stone 354,000 roubles (about 53,000*l*.) had been received for the building, 100,000 roubles (15,000*l*.) for teaching utensils, and 31,000 roubles (4600*l*.) for stipendia A library of more than 35,000 volumes is ready, and only waiting the building of the necessary apartments to house it

SCIENTIFIC SERIALS

Trimen's Journal of Botany, October, 1880–January, 1881 —Among the more valuable articles in the most recent numbers of this journal may be mentioned —*Musci præteriti* (new or badly-described mosses), by R Spruce —An account of the Acanthaceæ of Dr Welwitsch's Angolan herbarium, by S Le M Moore, with descriptions of a number of new species —On *Manihot Glaziovii*, the plant affording Ceara india rubber, by Dr. Trimen.—On a collection of Madagascan ferns, by J G Baker —On *Chara obtusa* (*stelligera* Bauer), a species new to Britain, by H and J. Groves —The history of the scorpioid cyme, by Dr. S. H Vines —On the plants of North Aran Island, co Donegal, by H. C. Hart, with a number of interesting shorter notices and articles

Journal of the Royal Microscopical Society, vol iii No 6 for December, with special index number, contains—The Transactions of the Society —Charles Stewart, on some structural features of *Echinostrephus molaris*, *Parasalenia gratiosa*, and *Stomopneustes variolaris*, with plate 20 —Dr H Stolterfoth, on the diatomaceæ in the Llyn Arenig Bach deposit.—Dr G W. Royston-Pigott, on a new method of testing an object-glass used as a simultaneous condensing illuminator of brilliantly reflecting objects such as minute particles of quicksilver.—The record of current researches relating to invertebrata, cryptogamia, microscopy, &c —The year's journal forms a volume of over 1100 pages, of which less than 200 are filled with the Transactions of the Society, and over 800 with the increasingly useful record With the February number will commence a new series

SOCIETIES AND ACADEMIES

LONDON

Zoological Society, January 4.—Prof W. H. Flower, LL.D, F.R.S., president, in the chair —Mr. Sclater exhibited and made remarks on a skin of the Southern Merganser (*Mergus australis*) from the Auckland Islands, belonging to the collection of Baron Anatole von Hugel.—Prof A Newton, M.A, F.R.S., exhibited on behalf of Prof. Alphonse Milne-Edwards, F.M.Z.S., an egg of *Cariama cristata*, laid last summer in the Jardin des

Plantes, and possibly the first ever seen of which the parentage was certainly known, though an egg, also exhibited by Prof. Newton, had been for many years in the collection of Mr. H. F. Walter.—Dr. Albert Günther, F.R.S., read an account of the zoological collections made by Dr. R. W. Coppinger, R.N., during the survey of H.M.S. *Alert* in the Straits of Magellan and on the coast of Patagonia, and called attention to the most remarkable species represented in the various groups, which had been worked out by himself and his assistants in the Zoological Department of the British Museum. Dr. Günther also called attention to several interesting cases of the similarity of forms in these collections to known forms of the Arctic regions and of the Australian seas.—A communication was read from Prof. J. O. Westwood, containing the descriptions of some new exotic species of moths of the genera *Castnea* and *Saturnia*.—A second paper by Prof. Westwood contained observations on two Indian butterflies—*Papilio castor* and *P. pollux*.—Prof. W. H. Flower, F.R.S., described the skull of a very large elephant seal (*Macrorhinus leoninus*), lately received in the Museum of the College of Surgeons from the Falkland Islands, and discussed the questions of affinities and systematic position of this animal among the Pinnipeds. Prof. Flower arrived at the conclusion from an examination of its dental, cranial, and limb characters, and from some other points in its anatomy, that the elephant seal is the member of the group the farthest removed from the terrestrial carnivora and showing most cetacean analogies. He also considered that at present there is no evidence of the existence of more than one species of the genus.—Dr. A. Günther read some notes on the species of insectivorous mammals belonging to the genus *Rhynchocyon* and *Petrodromus*, and described two new species of the former genus, proposed to be called *R. macrurus* (from the Rovuma River), and *R. chrysopygus* (from the Mombaça River).

PARIS

Academy of Sciences, January 3.—M. Wurtz in the chair.—M. Jamin was elected Vice-President for 1881, and MM. Decaisne and Edm. Becquerel were elected Members of the Central Administrative Committee.—M. Becquerel gave information as to the Academy's publications, and the changes among members and correspondents. Two members have died during the year, M. Chasles and General Morin, and seven correspondents, MM. Borchardt, Peters, Lissajous, Favre, Miller, Schimper, and Mulsant.—The following papers were read:—On magnetic oxide of iron, by M. Berthelot. The heat liberated in fixation of oxygen by iron decreases (for a given quantity of oxygen) as we pass from the protoxide to the magnetic oxide, then to the peroxide.—Researches of M. Fournier on the fall of the barometer in cyclones, by M. Faye. M. Fournier gives a formula for the progress of the barometer, and shows its validity by observations at the Island of Réunion.—Mr. Gould was elected Correspondent in Astronomy, in room of the late M. Peters.—On observations of the satellites of Jupiter at Toulouse Observatory in 1879, by M. Baillaud.—On a process of astronomical observation for the use of voyagers, dispensing with the measurement of angles for determination of latitude and of sidereal time, by M. Rouget. This is by observing two stars that have at a given moment the same altitude, combining such observations in pairs, and noting the interval between the two phenomena, &c.—Determination of the lines of curvature of all the surfaces of the fourth class, correlatives of cyclides, which have the circle of infinity for double line, by M. Darboux.—Measurement of the electromotive force of batteries, by M. Baille. He uses a torsion balance having a long wire (2.70m.) of annealed silver, and a lever with balls of gilt copper at each end. Similar balls are fixed at the angles of a rectangle, and diagonal pairs are in communication with each other. The lever, placed at equal distance from the fixed balls, is connected through the torsion wire with the + pole of a battery, the other pole being to earth. One pole of the pile to be measured is connected with the fixed balls. The deflections are read by reflection of an illuminated glass scale. The apparatus is enclosed in a metallic case connected with the ground. A thick envelope of wood-shavings is used to exclude disturbances from heat.—On the velocity of light: reply to M. Cornu, by M. Gouy.—Study on spectrophotometers, by M. Crova. Two spectra from different sources may be easily compared by covering half the slit of a photometric spectroscope with a small rectangular prism, the edge of which cuts the slit normally into two equal parts; one half receives one of the lights directly, the other, by total reflection, the other light placed laterally. Aberration can be corrected with a cylindrical lens. The elliptic polarisation from total reflection may be suppressed, by replacing a simple prism by two total reflection prisms superposed in contact.—On a method of reproducing speech in electric condensers, and particularly in the singing condenser, by M. Dunand. He connects one pole of a battery with one end of the induced wire of the coil, the other pole with one armature of the condenser, while the second armature is attached to the other end of the induced wire. (In the circuit of the primary coil are a battery and carbon microphone). In this way speech may be reproduced with perfect distinctness. The condenser giving the best effects was 0.06m. in length of side; it contained thirty-six sheets of tin foil. For the auxiliary battery two or three (Leclanché) elements will give weak articulate sounds. The intensity increases with increase of the number of elements, but not proportionally. The current of the auxiliary coil does not traverse the condenser.—M. du Moncel made some remarks on the subject.—On the vapour-density of iodine, by MM. Crafts and Meier. They study the variation of the density with the tension and with the temperature. The facts agree with the hypothesis of progressive dissociation.—On the direct preparation of chlorised and bromised derivatives of the methylic series, and especially of chloroform and bromoform, by M. Damoiseau.—On the functions of the small oblique muscle of the eye in man, by M. Fano.—Facts for the study of formation of fogs, by M. André. This relates to a case in which a high barometer was observed to sink suddenly (with rain), while a fog present disappeared, with slow rise of the barometer the fog reappeared.—New eruption of Mauna-Loa (Hawaiian Islands), by Mr. Green. This was on November 9.—On the formation of a thin layer of ice on the sea observed at Smyrna during the winter of 1879, by M. Carpentin. A slight breeze seems to have driven the waters of the Guedyzé against the quays of Smyrna, and there formed a thin layer on the surface, which froze in a complete calm on a clear night.—On a new use of electricity, by M. Grandt. This is, propelling vessels. A steam-engine drives one or more electro-dynamic induction apparatuses; the current is sent through a voltameter; the gases are conducted to an orifice in the keel, and exploded by an induction spark, with propulsive effect.

CONTENTS

THURSDAY, JANUARY 20, 1881

NORTH AMERICAN PINNIPEDS

History of the North American Pinnipeds: a Monograph of the Walruses, Sea-Lions, Sea-Bears, and Seals of North America. By J. A. Allen, Assistant in the Museum of Comparative Zoology at Cambridge. (Washington: Government Press, 1880.)

THIS bulky octavo volume forms No. 12 of the miscellaneous publications of the Department of the Interior, United States Geological and Geographical Survey of the Territories, which is under the charge of F. V. Hayden. It is a most important contribution to the life-history of the species of American Pinnipeds, for which the zoologist as well as the merchant may well thank both Mr. Hayden and Mr. Allen.

It is not an easy task to analyse a closely-printed volume of nearly 800 pages, but still we trust to be able to give our readers some notion of the general contents of this interesting work. Of the mammals, leading an essentially aquatic existence, the furred and fin-footed group have always had an importance and interest for mankind. The existing Pinnipeds constitute three very distinct families: these are the Walruses, the Eared Seals, and the Earless Seals. The first two are far more nearly allied than are either of these with the third. The Earless Seal is the lowest or most generalised group. The Walruses are really little more than thick clumsy fat forms of the Eared Seal group, with immensely developed canine teeth, and skulls modified so as to bear these. All the Pinnipeds have a high degree of brain development, and are easily domesticated under favourable conditions; they manifest strong social and parental affections, and they defend their young with great courage. They are, almost without exception, carnivorous, mostly feeding on fish, mollusks, and crustacea. While the Eared Seals are polygamous, the males greatly exceeding the females in size, the Walruses and the Earless Seals are thought to be monogamous, and there is very little difference between the size of the sexes. The polygamous species usually resort in large numbers to favourite breeding-grounds, the young are born on dry ground, and are at first unable to swim; while the monogamous forms do not so uniformly resort to particular breeding-grounds on land, and they leave the water only for short intervals. As a group the Pinnipeds are very distinctly characteristic of the Arctic, Antarctic, and temperate portions of the globe; very few range into tropical waters, and only one species can be said to be strictly tropical. While the Seals, Eared and Earless, are abundantly represented on both sides of the Equator, the Walruses are only to be found within the colder portions of the Northern Hemisphere. Of the family of the Walruses but two living species belonging to the genus Odobænus are known, the one, *O. rosmarus*, being the Atlantic Walrus; the other, *O. obesus*, the Pacific Walrus. The history of both species is here given at length: first a full synonymy is given; then the general history, accompanied by figures; then habits, products, food, and enemies. Among the figures given are those of Elliott of the head of the Pacific species, which give an idea of the uncouth facial aspect and of the strangely-wrinkled skin; but it is a pity that none of Elliott's representations of an adult form were reproduced from his work on Alaska, published in 1879, and of which only one hundred and twenty-five copies were printed. Capt. Cook's description of this species is still one of the best extant—a species that may soon disappear if the annual slaughter of ten to twelve thousand animals is allowed to continue.

The number of genera and species among the group of the Eared Seals has fluctuated immensely even within the last ten years. The views of Gray and Peters have repeatedly changed on this subject, "greatly," the author writes, "in the case of Gray, out of proportion to the new material he had examined." In Peters' latest enumeration he gives thirteen species: five are Hair Seals, or Sea-lions, eight are Fur Seals, or Sea-bears. Mr. Allen enumerates nine—two with doubt. Five are Hair and four Fur Seals. A good deal of this discrepancy doubtless arose from writers not having learnt to distinguish the sexes, and from their not making due allowance for the great changes in contour and details of structure that result in the skulls of these animals from age. The most striking fact in respect of the distribution of the Eared Seals is their entire absence from the waters of the North Atlantic. The Fur and Hair Seals have nearly the same geographical distribution; but though commonly found frequenting the same shores, they generally live apart. They are about equally and similarly represented on both sides of the equator, but are confined almost wholly to the temperate and colder latitudes. The Hair Seals have coarse hard stiff hair, and are wholly without soft under-fur, the abundant presence of which in the Fur Seals it is which makes their skins so valuable as articles of commerce.

The Eared Seals are all gregarious and polygamous. Their breeding-places have received the strangely inappropriate name of "rookeries." The strongest males generally secure to their lot from twelve to fifteen females. During the breeding season the males remain wholly on land, and they will suffer death rather than stir from their chosen spot. They thus sustain for a period of several weeks a continual fast. Steller's account, given nearly a century ago, applies still to nearly all the species. The "sea-fur" of the furriers is obtained from these Eared Seals with the under-fur. Fortunately the destruction of the Fur Seals at the Aleutian Islands, where at one time these seals were killed at the rate of 200,000 a year, has now been placed under rigid restrictions, and the same systematic protection ought to be afforded to them at all their stations. In 1877 Mr. Elliott calculated that the number—owing to the Government regulations—of Seals on the Alaska Islands had increased so as to leave 660,000 breeding females to be added to the original stock, and that the total number would not be much less than 1,800,000.

The description of the Earless Seals forms nearly one half of the volume. The technical history of the group is given at length and is most interesting. The genus Phoca of Linneus embraced four species now placed in four distinct genera and in three families. Since then 103 distinct specific and varietal names have been bestowed upon what our author considers as sixteen species. These are located in three sub-families and placed in

eleven genera. Copious synonymic details are given Of the restricted genus Phoca, three—*P. vitulina*, *P. Groenlandica*, and *P. fœtida*—are marine, and frequent the northern oceans, never descending anywhere near to the equator. A fourth, *P. Caspica*, is found in the Aral and Caspian Seas, and a fifth, *P. Sibirica*, is from Lakes Baikel and Oron. *Monachus albiventer* occupies an intermediate position (Mediterranean, Madras, and Canary Islands) between these northern forms and the Antarctic species, such as *Macrorhinus leoninus*, *Ogmorrhinus leptonyx*, *Ommatophoca rossi*, and the like. All the species have strong social instincts, and are almost unsurpassed in their affection for their young Most of them are gregarious; few of them are in the least ferocious, they are in general patient and submissive creatures, quite harmless to man. Fond of basking in sunshine, they spend a good deal of their time out of the water, on bank, rock, or ice. They are very voracious, eating fishes, or in lack of these, mollusks and crustacea. Strange though it may seem, the young seals take to the water reluctantly, and have to be actually taught to swim by their parents The young of some species remain on the ice until they are from two to three weeks old, or until they have shed their first soft woolly coat of hair; their cry is more of a bark than a roar, that of the young is a kind of tender bleat, putting one in mind of the cry of a young child Dr. Murie (*Proc* Zool Soc London, 1870) has characterised three distinct modes of terrestrial locomotion among these Seals, from which it would appear that the Phocine Seals generally have considerable power of movement upon land

The Seal-hunting districts are described at length, the oil and skins of these Seals having a large commercial importance The Dundee sealers took in 1876 nearly 40,000*l* worth. The habits of the various species form a most interesting portion of this division of the volume, and the author seems to have ransacked every treatise on the subject so as to make his own complete. This history of the North American Pinnipeds will long remain a perfect monograph of a valuable and important group of mammalia.

CATALOGUE OF NEWCASTLE LIBRARIES

Newcastle-upon-Tyne Public Libraries. Catalogue of the Books in the Central Lending Department Compiled by W. John Haggeston, Chief Librarian. (Newcastle-upon-Tyne: 1880)

NO portion of a book draws more heartfelt commendation or more earnest rebuke from a critic who has read it, not for the purpose of criticising, but for that of using its information, than the index. Only the reader who picks up a book for recreation and amusement feels at all independent of it; and even he appreciates its importance if any future reference is required. And if a good table of contents is so requisite in the case of a single book, how far more so must one be in a large library.

We have here a new catalogue of a new library, a selection of 20,000 volumes of books chosen for their readable value only (which perhaps justifies the omission of all dates of publication of the books, which would be a fault in a catalogue of most libraries), and consequently we may look to it as a model of what a catalogue should be. And we shall not be disappointed. It is drawn up on the same scientific principles worked out so fully in Dr. Billing's catalogue of the U.S. Surgeon-General's Office, which we noticed lately, and these so well worked out too, that really it is a table of contents of the library; the matter contained in the volumes of the latter as well as their titles are all laid before us. Each work is entered under the author's name, under the title, and, in cases where that title is compound, under each of the subjects it may include Under the heading of each principal subject treated a reference is again given to the work with its library number, and so numerous are these cross references that on an average every volume throughout the library appears four times over. Indefinite titles are rectified by a summary being given, in a smaller type, of the matters discussed

Catalogues which limit themselves rigidly to the contents of the title-page abandon all attempts at completeness, since many titles do not even pretend to express the subjects of the book (need we cite Mr. Ruskin's?), and many equally fail in the attempt As the field of literature increases, and not even a librarian can keep himself acquainted with the ground gone over by all the books under his care, a subject-catalogue as well as an author- and title-catalogue becomes a necessity, and, if it is well drawn up, though it may cost both money and time, they will be well spent Volumes that appear unattractive enough to the general reader, and are far too numerous for the ordinary student to search through, become suddenly, through a subject-catalogue, of the greatest value to both of them The books in a library whose contents are thus laid open to its frequenters will be read with profit much greater than would a considerable fraction more books whose title-page was all the introduction their readers had to them.

And the saving of time when it is completed will be immense It will save the time of the librarian by preventing hundreds of inquiries being made at all, and still more by strengthening the hands of his assistants, who will be capable of working his catalogue to the utmost and answering a very large proportion of such inquiries as are made by readers who may be awkward at it, it will save the time of the busy man, who wants his information at once, it will save the time of the student who wants the most recent information which he can get, and it will save the time of all by making fewer changes of books necessary.

All this is doubly important in a Free Library, because, as any one taking an interest in these institutions will have marked, those of its readers who do not confine themselves to novels seldom take out books for the mere pleasure of reading, as the higher classes do Reading has not yet become a recreation to them, but they go to the library as to a great encyclopædia to get information on certain subjects, often of the most technical character, and a catalogue that directs them to the very book they want doubles and trebles the value of the library to them. They have no time to read all the *critiques* and *résumés* of new books with which the press teems, and which make the style and contents of many such works familiar to readers of periodicals who may never have seen the works

themselves. Where hundreds go in an evening for books it is impracticable to allow them access to the shelves of the library to select them, while in an ordinary bare list of titles it is impossible for them to judge which book in a column will be found the one most to their requirements

Like Dr Billings, our Newcastle librarian has fully worked out a most important branch of a subject-catalogue Magazine literature in these days has become far too important to be treated by either a thrifty librarian or an inquiring student as "fugitive" and "ephemeral." All the newest science now appears first in journals, and all leaders of thought give their first expression of it in magazines and reviews. In this new catalogue therefore we are much pleased to see that not only is each volume of all important periodicals entered separately with its list of articles, but, as we have said, under the head of each subject a reference is given to all of such articles as bear upon it. By this means students who have read a standard work published a few years ago upon any subject will be not only guided but stimulated into reading the latest researches or theories which these publications contain It is perhaps going beyond our subject, but we cannot help noticing how convenient for this important purpose a card-catalogue at a library is, in which cards containing the subject of each article down to the last number of all the magazines have been dropped into their places Such an arrangement would make many students feel a printed catalogue to be ancient by the time it was published

The selection of books as a whole is admirable—though of course few selections have been made under such favourable circumstances We are rather surprised in so large a list to note the absence of books like Boyd Dawkins's "Cave-Hunting" and "Early Man in Britain," Clifford's "Lectures and Essays," Croll's "Climate and Time," Moseley's "Naturalist on board the *Challenger*," and Sir Wyville Thomson's book; Hæckel's "History of Creation" and "Evolution of Man", Schliemann's "Troy" and Cesnola's "Cyprus", Wallace's "Geographical Distribution of Animals," &c. And if some of these are so costly as to be confined to the Reference Library, as is probably the case here, still we are sorry to miss Wallace's "Tropical Nature," and R. Jefferies ("The Gamekeeper at Home") with his series of books teaching men to open their eyes as they move about the fields and lanes.

The printing is a credit to both printer and editor It is almost as funny as the "Ingoldsby Legends" to read "Life and Remains of *Dean* Hook," by Barham! but it is plainly a slip, and the smallest errors are very scattered.

The Rules and Regulations are clumsy to enforce, which indeed will probably not be attempted, at any rate for long. The annoyance of having to get a guarantor practically shuts out many whose hitherto idle life might have taken a fresh start if books had been put into their hands freely. We have been very pleased to see that several large libraries have done away with this irritating system without any loss of property, and it seems a step backwards when a new institution like this starts with more rigid and inconvenient rules than many others. Indicators are capital things in libraries to which each reader goes for his own book as at a university, but only very few of the hundreds who exchange books every night at a flourishing Free Library are at all able to work with them. Children are the usual messengers, not high enough to consult an Indicator of 20,000 volumes It is an unmerciful rule that borrowers should return their books personally, and a downright unreasonable one that every book must be returned in a fortnight (Rule 17), NOT to be re-issued the same day (Rule 16), although we are told (p. vi) that three-volume works are issued complete Few Free Library readers can get through 600 or 800 pages in a fortnight. And surely it was not necessary to threaten each person who consults the catalogue with imprisonment *with whipping* if he defaces a book! It may be necessary to make such Draconian laws, but they should be brought forward to intimidate gross offenders, not flourished in the face of all whom we wish to attract. Such severe rules repel sensitive people, while from their very familiarity they lose their effect on the careless

OUR BOOK SHELF

Botanische Jahrbucher fur Systematik Pflanzengeschichte und Pflanzengeographie Herausgegeben von A Engler Erster Band, zweites Heft (Leipzig Wilhelm Engelmann, 1880)

THIS part includes four papers. The first is by W O Focke, on the natural divisions and geographical distribution of the genus Rubus The characters chiefly discussed are —1 Mode of growth or habit. 2 Forms of leaf which are very numerous the duration of the leaf being also variable. 3 Characters derived from the stipules, which are considered of great value 4. Inflorescence, and 5 the Structure of the flower The number and size of the parts of the calyx and corolla vary, as also the colour of the corolla The stamens vary in closely allied species, and while most of the species are hermaphrodite, some are unisexual The structure of the gynæcium is very varied, the number of carpels being five or six in some, as in *R. dalibarda*, or above 100, as in *R rosæfolius* The hairs (trichomes) on the different parts of the plant are very numerous and remarkable for the variety of structure shown, no other group, except perhaps some Solanaceæ, approaching the Rubi in this particular In regard to the geographical distribution the most important points are —1 The characteristic difference in the Rubi of Eastern Asia and Europe. 2 The predominance of European forms in the Atlantic, and of East Asian forms on the Pacific side of America 3 The occurrence of south Chinese and north Indian types in Mexico and Peru These peculiarities Focke would explain on geological grounds

The second paper is by Franz Buchenau on the distribution of Juncaceæ over the world The author gives a complete list of the species of the genera Juncus Luzula, Rostkovia, Marsippospermum, Oxychloe, Distichia, and Prionium, and a table showing their distribution into regions nearly corresponding to those of Grisebach.

Koehne, in the third paper, gives the first portion of a monograph of the Lythraceæ, including a key to twenty-one genera. He admits and then describes thirty-one species with numerous varieties of Rotala (Ammania, Linn, Benth., and Hooker)

The last paper is by Engler Contributions to the knowledge of the Araceæ, in which he describes some new Araceæ from the Indian Archipelago and Madagascar, and also directs attention to the cultivation of *Zamioculcas Loddigesii* from the detached leaflets of the remarkable pinnate leaf of the plant. A swelling occurs at the base of the leaflet, and in a few days a small tuber is produced which develops two buds, below each of which roots are formed The plant has been propagated in this way by Herr Hild of the Kiel Botanic Garden.

The Fishes of Great Britain and Ireland By Dr. Francis Day, F L S, &c. (London. Williams and Norgate, 1880.)

THIS work is to be issued in nine parts, of which the first, containing sixty-four pages of text and twenty-seven plates, is now published. Waiting until the completion of the work for a more extended notice, we may for the present mention that in it the author purposes to give a natural history of the fishes known to inhabit the seas and fresh waters of the British Isles, with remarks on their economic uses and on the various modes of their capture, and that an introduction to the study of fishes in general is promised.

The synonymic lists of the species are given in great detail, the descriptive diagnoses treat of internal peculiarities as well as of external form, a good many interesting details appear under the headings of Habits, Means of Capture, Baits, Uses The plates are from drawings by the author, and are very excellent

A Manual of the Infusoria By W Saville Kent, F L S. (London David Bogue, 1880)

THIS sometime promised work has now advanced so far in its publication as the third part, when completed it will merit a somewhat lengthened notice, as the most important work on the subject which has issued from the British press It is intended to include a description of all known flagellate, ciliate, and tentaculiferous Protózoa, British and foreign, and an account of the organisation and affinities of the Sponges Each part (roy 8vo in size) contains over 140 pages and eight plates. The general get-up of the work is magnificent, rather too much so for the poor student, already weighed down by the burden of the parts of Stein's "Infusionsthiere," but very pleasant for the book fancier, and forming an imposing shrine wherein to inclose the records of these early-life forms

The first five chapters (pp 1-194) are introductory, treating of the general history of the group on the subkingdom Protozoa, on the nature and organisation of the Infusoria, on spontaneous generation, on the nature and affinities of the sponges The sixth chapter treats of the systems of classifications of the Infusoria, adopted by various authorities, from the time of O F. Muller to the present date The seventh chapter commences the systematic description of the Flagellata The third part, just published, carries the work as far as the 432nd page and to the twenty-fourth plate

A Complete Course of Problems in Practical Plane Geometry with an Introduction to Elementary Solid Geometry A New, Revised, and Enlarged Edition By J W. Palliser (London Simpkin, Marshall, and Co, 1881.)

THIS is a cheap manual, the cost of which can be easily met by any artisan desirous of studying the subject, while at the same time its contents enable it to fully satisfy the wants of all examinees in first, second, and third grade and similar papers of the Science and Art Department Examinations The figures are very clearly drawn, well showing given, constructional and required lines, the form of the page enables four propositions to be fully treated of with the accompanying figures in four spaces on each page. In the constructions we do not look for novelty, but we have conciseness and great clearness generally prevailing. Here and there elegance of expression is sacrificed to brevity ("for all the Government examinations, the requirements of which this is a text-book, the same rules will apply, with exception of Nos. 1 and 6") We have detected only three points which call for our notice in Prop. 12 it strikes us as being simpler to use the same radius throughout, thus doing away with the necessity of taking two cases, as Mr. Palliser does; in Prop. 37, *note*, it is necessary to add *how* the point is obtained; in Prop. 212 the letter E is made to do double duty in the proof. We can confidently recommend the book

Bericht über die Thätigkeit der Botanischen Section der Schlesischen Gesellschaft im Jahr 1877. Erstattet von Prof Dr Ferdinand Cohn

MOST of the papers in this part are in abstract; a few however are given at some length, and are of considerable interest The additions to the phanerogamous Flora of Silesia and the record of new localities for rare plants occupy a considerable part of the pamphlet Perhaps the most interesting paper is that on the Date-palm and Palm-forest at Elche in Spain, by General von Schweinitz The palms there grow to a height of from seventy-five to eighty feet The plants grow for about 100 years, then become stationary, and next decay. Each tree bears from the fifth year two to five bunches of fruit, each with from 500 to 600 dates, the weight of dates yielded by one tree being sometimes three centners Many of the papers in this part are contributed by Goeppert and Cohn, and deal with all departments of botany Dr Thalheim describes a series of models of diatoms made in paraffin and glycerine soap, which exhibited the structure of all the chief groups of this order of plants

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications

The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Dr. Carnelley's Hot Ice

THE remarkable observation made by Dr. Carnelley that ice in a vacuum is very permanent, even though surrounded by and apparently in contact with very hot bodies, has caused him to suppose and maintain that the ice itself is at a high temperature, a supposition which has been apparently confirmed by preliminary calorimetric determinations. This proposition has naturally met with a good deal of scepticism, and certainly requires ample and cautious verification, but I venture to think that there is nothing in it contradictory to our present knowledge of the properties of matter, though if verified (as, for the reasons to be stated, I fully believe it will be) it constitutes an important addition to that knowledge.

The notions which have occurred to me have made the essential part of the phenomenon so much clearer to myself that I fancy they will not be uninteresting to your readers

By the term "vapour-tension" at a given temperature I mean, as I believe is usual, the pressure at which a liquid and a vapour can exist permanently together at that temperature, or the maximum pressure which the vapour is able to exert at that temperature, or the vapour pressure under which a liquid ceases to evaporate, or the total pressure at which it begins to boil By the term "boiling-point" I mean the temperature of a liquid under a total pressure equal to its vapour-tension.

Now in order that a solid may sublime or pass directly into the vaporous condition without melting, it must be either at a temperature below the melting-point, so that no liquid attempts to form, or else at such a temperature that any liquid formed shall instantly evaporate; which it would certainly do if it were above the boiling-point, that is if the total pressure on it were less than the vapour tension

A solid, under either of these circumstances, gives off vapour from its free surface at a rate depending on, but not necessarily proportional to, the supply of heat; for there is no definite subliming point for a solid, any more than there is a definite evaporating point for a liquid, so that the temperature of the solid need not remain constant. When a liquid is evaporating, the more you heat it the faster it evaporates, but not at a compensating rate, and the temperature rises as well: if this be true for a liquid, much more will it be true for a solid, whose

evaporation is always more encumbered, partly, no doubt, because its evaporating surface is a fixture. The only limit to the rise of temperature of a liquid is its boiling, but if this be prevented it may get superheated, and, unless the solid boil (*i.e.* disintegrate internally) it can become superheated to any extent. The possibility of this internal disintegration we will examine directly, but at present we will consider it practically *nil*.

Let us grant then that a subliming solid always rises in temperature if heated at a sufficient rate, and Dr. Carnelley's proposition follows.

We have seen that no liquid can exist at temperatures below its freezing- or above its boiling point, so that if we wish to prevent the possibility of its existence, we need only make these two points coincide. This can always be done by diminishing the pressure, for the boiling-point of all substances is greatly affected by changes of pressure, while the freezing-point is only slightly altered, and even, in the case of ice, in the opposite direction.

Start then with the solid below its melting-point, and reduce the pressure on it till the boiling point coincides with, or passes below the melting point. There is now no region where liquid can exist, and the solid must therefore sublime, but, by our supposition, a subliming solid if heated will get hot, hence the solid may now assume any temperature you please, and the hotter it gets the more pressure may be brought to bear upon it without causing it to melt, *i.e.* the pressure may be allowed to increase to anything short of the vapour tension at the new temperature. If heated sufficiently, then the whole atmospheric pressure may be let in, and no melting will occur. All that is necessary is that heat shall be supplied at a sufficient rate to compensate for the rapid evaporation (which however will not be so rapid as in the vacuum), and to prevent its temperature falling to the boiling-point, for if it reached this, part (or all) would quickly liquefy, and the whole fall to (or towards) the melting point.

Thus we have the remarkable proposition that if, by the process of lowering the boiling-point to coincide with or pass below the melting-point, we manage to get ice across the gap which ordinarily separates these two points, it may be heated to 120° or to any other temperature, and that when at 120° it will be permanent, and will not melt even under the whole pressure of the atmosphere. To prevent its melting you must keep on heating it: if allowed to cool to 100°, five-eighths of it will be instantly crushed to water, and the whole will be at 0° (assuming, what is not likely to be correct, that the specific heat of hot ice is ½).

There is still the question of the possibility of internal melting or sublimation to be considered.

Now I suppose that if a solid is perfectly homogeneous, a change of state in its interior would with great difficulty occur, and the solid might readily be superheated. But an excess of pressure at any point, such as would be produced by a bubble of air, would readily determine a melting-centre. In Prof. Tyndall's ice-flower experiment the nuclei are probably minute bubbles of air, and the ice walls of the cavities so produced are subject to the pressure of this air in addition to that of the vapour, and accordingly melting sets in and spreads. But Dr. Carnelley's ice is formed *in vacuo*, so that no air bubbles are possible, and the only nuclei that can properly exist are little bubbles of enclosed vapour, and these, I imagine, can scarcely be absent. Let us inquire then what can happen in the case of one of these bubbles when the temperature of the ice is raised either by radiation or conduction. Initially, while the temperature is constant, the vapour is saturated; but no liquid is formed because this temperature is below the melting-point. When heat is applied, the ice, being less diathermanous than the vapour, will get heated first, and so long as the temperature keeps rising it will always be a little hotter than the vapour, which consequently is not quite saturated, and the pressure it exerts is less than the "vapour-tension" (*i.e.* the temperature is above the boiling point), and no water can be formed. The cavity will of course enlarge by sublimation, but very slowly, much more slowly in fact than outside, if a vacuum is there artificially maintained.

But if cooling be permitted the ice will cool the fastest; and the vapour at once becomes over-saturated and condenses. The temperature is now below the boiling point, and liquefaction instantly sets in and rapidly spreads, the ice consuming its own heat in the process.

Internal disintegration therefore will not occur while the temperature is rising, but it will set in at a great pace if it be allowed to become stationary or to fall, unless there be an utter absence of nuclei. If the temperature rises very high the pressure of the internal vapour will of course be great, and ultimately might even be able to burst the ice, but this would scarcely occur under several atmospheres.

It would be interesting if Dr. Carnelley would kindly try the following experiments:—

1. Heat ice *in vacuo* with a pressure gauge, and, still heating it, stop the passage to the condenser so that the pressure is allowed to accumulate, and note the pressure and temperature when collapse occurs.

2. Heat ice up to any temperature, and, still maintaining a good vacuum, remove the supply of heat, and see if the ice does not collapse.

3. Heat the ice up to 120°, and, still heating it, let in the atmosphere gently (but make the air come in through hot pipes, or it will melt the ice), and see if the ice does not last rather longer than it would have done in the vacuum, because the evaporation will be more obstructed. But if the second experiment succeed, the temperature must never be allowed to fall much or to remain stationary long.

Finally, it is important to point out explicitly that the Carnelley experiment has no bearing on the change of the melting-point of ice with pressure. Our knowledge on this point remains as it was, viz. that the value of $\frac{d\theta}{dp}$ about zero centigrade is $-\cdot0071$, that is to say, the melting-point rises and falls about $\cdot0071°$ centigrade per atmosphere of pressure decrease or increase.

Of course this number is not absolutely constant, but its variation with pressure is very slight, and moreover has no bearing on the Carnelley experiment, as was naturally but erroneously supposed by Prof. Pettersson in the *Berichte* (18), and I believe also by Prof. Ayrton at the Chemical Society, though I had not the pleasure of hearing his remarks.

University College, London OLIVER J. LODGE

Note.—With reference to the above second experiment and the reasoning which suggested it, it is important to remark that I have all along assumed that the vapour tension of ice at any temperature is precisely the same as that of water at the same temperature. But Prof. Foster considers it possible that the vapour tension of ice may be less than that of water, and would hence explain the permanence of vapour inside an ice-cavity without attending to whether the temperature were rising or falling, provided it were not falling too fast. This would be a most important fact to discover and verify, but I think the Carnelley experiment in its present form does not inform us concerning its truth or falsity.

Another thing it may be interesting to note is the rate of variation of boiling-point with pressure at different temperatures, which can be calculated on thermodynamic principles (after Prof. James Thomson) from empirical data for the latent heat of steam, and for the density of saturated steam at any temperature.

It is, at the temperature θ and the pressure p,—

$$\frac{d\theta}{dp} = \frac{\theta^2}{273 \times 1\cdot008 \times (796\cdot2 - \cdot695\,\theta)/p}$$

a fraction which has the value 28 at 100° C., and 2180 at 0° C.: these numbers represent the rate of rise or fall of boiling point in centigrade degrees per atmosphere increase or decrease.

Integrating this equation, we get the value of the vapour-tension p of water in atmospheres (megadynes per square centimetre) at any absolute temperature θ, viz.—

$$\log p = 9\cdot1728 \left\{ \cdot695 \log \frac{373}{\theta} + 796\cdot2 \left(\frac{1}{373} - \frac{1}{\theta} \right) \right\},$$

the logarithms being to the base *e*.

On the Spectrum of Carbon

I HAVE a great respect for Dr. Watts's spectroscopic work, nevertheless the experiments he has described in NATURE, vol. xxiii. p. 197, appear to me singularly inconclusive for the purpose for which he has adduced them. How could any one expect to get a tube of gas free from hydrocarbons when the joints were of india rubber and melted paraffin? I have long since found it necessary to forego rubber joints if I would exclude hydrogen. Salet has shown that the hydrocarbons from the blowpipe flame used in sealing in wires, &c., and the last traces of dust, can only be removed from tubes by burning them out in a current of oxygen. But more than this, I have found

that even with joints all made by fusion of the glass it was well nigh impossible to get rid entirely of hydrogen. Mr Crookes has, I believe, found that the last traces of moisture adhering to glass can only be expelled by heating to the softening point of the glass. This tallies with my own experience. In a series of experiments on the ultra-violet water spectrum I had occasion to photograph the spectra of sparks in sundry gases wet and dry, and found that in gases which had been passed through a tube full of phosphoric anhydride the water-spectrum still appeared strongly. Even when the gas had been passed very slowly through two tubes each half a meter long filled with calcium chloride, and then through a similar tube full of phosphoric anhydride, and the part of the tube where the wires were sealed had been heated strongly for a long time, while the current of gas was passing, traces of the water spectrum still often appeared. But Dr Watts did not see the hydrogen lines in his tube My difficulty has always been to avoid seeing them when the pressure of the gas was sufficiently reduced and a large condenser used with the induction coil. True: tubes of gas may not always show them even when hydrogen is known to be present The spark takes a selected course of its own, and does not always light up all that is in the tube Carbonic oxide does not generally show oxygen lines, and in tubes exhausted by a Sprengel pump the lines of mercury do not usually appear until the pumping has been carried far. A real test would be to see whether when the spark gives the line-spectrum of carbon the hydrogen lines do not also appear. The experiment with naphthaline Prof. Dewar and I have repeated and discussed elsewhere, so I will say no more on it than this, that purity in regard to chemicals is a relative rather than an absolute quality, and that it is only from a long series of experiments chosen with a view to eliminate the effects of accidents of all kinds that any safe induction in this kind of spectroscopy can be reached

Cambridge, January 4 G D LIVEING

[To save time we submitted Prof Liveing's letter to Mr Watts, who sends the following reply —ED]

I SEE no reason why india-rubber stoppers may not be used in the construction of an apparatus to be filled with a gas *at atmospheric pressure*, or nearly so The case would be altogether different if we were concerned with the construction of a vacuum tube, and I take it that most of these statements of the difficulty of getting rid of the last traces of moisture and of hydrocarbons adhering to the glass refer to cases where the pressure is to be only a few millimetres But when a current of cyanogen at atmospheric pressure, made from dried mercuric cyanide, is passed through a U-tube filled with phosphoric anhydride, the gas is surely dry to all intents and purposes (I do not say that the glass would not give off traces of moisture, &c , if the pressure were to be reduced to an extreme point) , at least there can be so little hydrogen present in the tube that to ascribe the spectrum given by the tube to the hydrogen present in it is to adopt an extreme hypothesis, which must be supported by cogent experimental evidence before it can be accepted.

But if the defect of the experiment be in the use of india-rubber there can be no great difficulty in constructing the apparatus entirely of glass, and if we are to give up the view that the groups δ (5165 to 5082) and γ (5635 to 5478) are due to carbon, it must be shown that they are not present in the spectrum of the spark in cyanogen at atmospheric pressure when sufficient precautions are taken to obtain the gas pure. I have never examined the spectrum of the spark in cyanogen without seeing them, and have every confidence that Prof Liveing will still find them there after he has taken all the precautions he may think necessary.

But admitting for the sake of argument the justice of Prof. Liveing's contention that the cyanogen in my experiment contained a trace of hydrogen and that the naphthalin contained a trace of nitrogen, then this seems to be the theory offered for our acceptance—that the spark in nitrocarbon gas containing a trace of hydrogen gives the lines of hydrocarbon, and that the spark in hydrocarbon gas containing a trace of nitrogen gives the lines of nitrocarbon. Does Prof Liveing hold *both* of these hypotheses to be reasonable ? W. M. WATTS

Geological Climates

THE letter of Prof. Haughton in last week's NATURE so bristles with figures and calculations that some of your readers may feel a little puzzled and may be unable to detect the fallacies that lurk among them. The question is far too large a one to be fully discussed in your columns. I shall therefore confine myself to pointing out the erroneous assumptions and false inferences which vitiate all the learned Professor's calculations, having done which my own theory will remain, so far, intact.

The whole argument against me is based upon an "ideal ice-cap," extending from the Pole to lat 60°. A considerable but unknown thickness is given to this imaginary field of ice, and it is then calculated that the three great ocean streams, even if admitted to the Arctic area in the manner I suggest, would not get rid of this mass of ice There are however several important misconceptions and illogical deductions underlying the whole argument, and when these are exposed the results, however accurately worked out, become completely valueless

We first have it stated that if heat and cold were uniformly distributed over the Polar regions the whole would be permanently frozen over, and an ice-cap be formed of great but varying thickness, diminishing from the Pole to about lat 60°. But even this preliminary statement is open to serious doubt; for ice cannot be formed without an adequate supply of water, and over a large part of the Polar area no more snow falls than is annually melted by the sun and by warm southerly winds blowing over the heated land-surfaces of Asia and America. Admitting however that any such ice-cap could be formed, it would certainly not form in *one year* but by the accumulations of a long series of years , and any estimate of the *total* heat required to melt it has no bearing whatever on the *annual* amount that would be sufficient, since this depends solely on the average thickness of the ice *annually* formed, of which Prof. Haughton says nothing whatever.

The amount of rainfall in the Arctic regions (mostly in the form of snow) is certainly very small. It is estimated by Dr Rink to be only twelve inches in Greenland, and this is probably far above the average. All that falls on the inland plains of Asia, Europe, and America is however melted or evaporated by the action of the sun and air far from the influence of the Gulf Stream. The thickness of ice formed annually over the whole area of the Arctic Ocean I have no means of estimating In open water in very high latitudes it may be considerable, but perennial ice-fields can only increase very slowly. I should therefore very much doubt if the thickness of ice now formed annually over the whole Arctic area averages nearly so much as five feet , and Prof. Haughton himself calculates that our own Gulf Stream is now capable of melting this quantity

The first assumption, therefore—that the amount of heat required to be introduced into the Arctic regions in order to raise their mean temperature above the freezing-point is "accurately measured" by the amount required to melt an "ice-cap" covering the whole area to a thickness of several hundred feet—is grossly erroneous , and it is so because it takes the hypothetical *accumulated* effects of *many years* Arctic cold under altogether impossible conditions, and then estimates the amount of heat required to melt this whole accumulation in *one year* !

But we find a second and equally important error, in the assumption (involved in all Prof Haughton's arguments and figures) that all the ice of the alleged "ideal ice-cap" must be melted by that portion of the Gulf Stream which actually enters the Polar area, where its temperature is taken to be 35° F. or only 3° above the melting point of ice A large quantity of the Arctic ice, however, even now floats southward to beyond lat. 50° in both the Atlantic and Pacific, and is melted by the warmer water and atmosphere and the hotter sun of these lower latitudes. Now, as it is an essential part of my theory that much of Northern Asia and North America were under water at those early periods when warm climates prevailed in the Arctic regions, it is clear that whatever Arctic ice was then formed would have a freer passage southwards, and as the south-flowing return currents would then have been more powerful and more extensive than at present, a much larger proportion of the ice would have been melted by the heat of temperate instead of by that of Arctic seas

Prof. Haughton admits that the Kuro Siwo and the Mozambique currents together, if they entered the Polar seas, would be equal to the melting of a layer of ice more than thirteen feet thick over the whole area down to lat. 70°. But if our own Gulf Stream is sufficient to get rid of the whole of the ice that now forms annually—as Prof. Haughton's figures show that it would probably be, and as it would be still more certainly were Greenland depressed, thus ceasing to be the great Arctic refrigerator and ice-accumulator—then the heat of the other two currents would be employed in raising the temperature of the Arctic seas above

the freezing-point; and if we take the area of the water as about equal to that of the land, we shall have heat enough to raise the whole Arctic ocean to a depth of full 180 feet more than 20° F., or to a mean temperature of 52° F., and as this would imply a still higher surface temperature it is considerably more than I require.

Unless therefore Prof. Haughton can prove that the amount of ice now forming *annually* in the Polar regions is *very much more* than an average of five feet thick over the whole area, his own figures demonstrate my case for me, since they prove that the rearrangement of land and sea which I have suggested would produce a permanent mild climate within the Arctic circle and proportionally raise the mean temperature of all north-temperate lands.

Briefly to summarise my present argument:—Prof. Haughton's fundamental error consists in assuming that the true way of estimating the amount of heat required in order to raise the temperature of the Polar area a certain number of degrees is,—first, to suppose an accumulation of ice indefinitely *greater* than actually exists, and then to demand heat enough to melt this accumulation *annually*. The utmost *possible* accumulations of ice in the Arctic area, during an indefinite *number of years*, and under the most *adverse physical conditions* imaginable, are to be all melted in *one year*, and the heat required to do this is said to be the "accurate measure" of that required to raise the temperature of the same area about 20°, at a time when there were no such great accumulations of ice and when all the physical conditions *adverse* to its *accumulation* and *favourable* to its *dispersal* were immensely more powerful than at present!

When this fundamental error is corrected, it will be seen that Prof. Haughton's calculations are not only quite compatible with my views, but actually lend them a strong support.

ALFRED R. WALLACE

By the courtesy of Mr. Ingram I am enabled to say that the tree at Belvoir supposed to be *Araucaria Cunninghami* is in reality, as surmised by Capt. King, *Cunninghamia sinensis*. The *Cunninghamia* is a native of Southern China, whence it has been introduced into Japan. In this country it was originally grown under glass, but, as the instance at Belvoir illustrates, such protection is not absolutely requisite. The tree is however somewhat tender, and so far as I know has never produced its cones in this country in the open air.

As to the Bamboos hardy in this country, it may be well to warn those who are not familiar with the plants not to expect to see the gigantic and rapidly-growing grasses that go under this name in the tropics. Rarely indeed do they attain in this country the dimensions even of the *Arundo donax*, so familiar to travellers in Italy. As accuracy of nomenclature is proved in this and the foregoing instance to be a matter of much moment, it may be well to say on the authority of the late General Munro that the Himalayan plant commonly grown in gardens as *Arundinaria falcata* is more correctly called *Thamnocalamus Falconeri*, that the *Bambusa gracilis* of gardens is the true *Arundinaria falcata* of the Himalayas, and that the Japanese *Bambusa metake* is *Arundinaria japonica*. General Munro's monograph of this group is to be found in the twenty-sixth volume of the *Transactions* of the Linnean Society, part 1, 1868, while his remarks on the cultivated species may be found in recent volumes of the *Gardeners' Chronicle*, particularly in vol. vi. 1876, p. 773.

The simultaneous flowering of *Thamnocalamus Falconeri* a few years ago in all parts of Europe created much attention, and was indeed a remarkable illustration of hereditary tendency manifested under very varied climatal conditions. The flowering of this grass was by no means looked on with unmixed gratification, as it entailed as a consequence the death or protracted enfeeblement of the plant.

A visit to Kew or to any of our larger nurseries will suffice to show that there are other Bamboos (that is, grasses belonging to the group *Bambuseæ*, if not true Bambusas) which are hardy enough to withstand even such rigorous winters as those of 1878-9 and 1879-80.

MAXWELL T. MASTERS

Climate of Vancouver Island

THE letters on this subject which have appeared in NATURE (vol. xxiii. pp. 147, 169), have reminded me of a "Prize Essay on Vancouver Island. By Charles Forbes, Esq., M.D., M.R.C.S.Eng., Surgeon Royal Navy," which was published by the Colonial Government in 1862. It consists of sixty-one closely-printed octavo pages and eighteen pages of Appendix, the latter containing several Tables on the Meteorology of the Colony.

The following is a portion of the "Abstract of Meteorological Observations, taken at the Royal Engineer Camp, New Westminster, during the year 1861, by order of Col. R. C. Moody, R.E., Commanding the Troops. Lat. 49° 12′ 47″ N., Long. 122° 53′ 19″ W." (p. 3, Appendix):—

Max. temp. of air in shade at	9.30 a.m.,	July	9,	74.3° F.
" " "	3.30 p.m.	"		84.0 "
Mean " "	9.30 a.m.			48.8 "
" " "	3.30 p.m.			52.2 "
Min. " "	9.30 a.m.,	Jan.	21,	20.0 "
" " "	3.30 p.m.,	Dec.	23,	24.0 "
Min. temp. on grass on January 21				10.0 "

All the observations were made at 9.30 a.m. and 3.30 p.m. daily throughout the year.

WM. PENGELLY

Torquay, January 6

Dimorphic Leaves of Conifers

IT is now generally believed that some of the varying forms assumed by individual plants or animals in the course of their development are as it were the reflex of an ancestral state of things. From this point of view the different forms of leaves assumed by some Araucarias, as well as by many other conifers, become of particular importance. The Retinosporas now so common in our gardens and on our balconies represent an immature stage of some Thuya, the proof of which statement is occasionally furnished by the plants which suddenly assume the foliage characteristic of that genus. In various species of juniper, notably in the Chinese juniper, two forms of leaf representing the juvenile and the adult condition occur together on the same branch.

Assuming that the juvenile, or "larval" forms, as they have been called, do really represent previous conditions in the history of the species, it might be expected that some of the fossil coniferæ would be characterised by the possession of this larval foliage to the exclusion of any other. But if I mistake not both forms of foliage have been met with in fossil as in recent conifers, and the pedigree of these plants is by so much the more pushed back.

The resemblance in the form and arrangement of the adult leaves in some Thuyas and allied plants to the disposition of the leaves in Selaginella should not be overlooked in this connection nor the close resemblance between the foliage of some species of Lycopodium proper and the "larval" leaves of many conifers as above referred to.

MAXWELL T. MASTERS

Dust and Fogs

THE meteorological conclusions of Mr. Aitken's important paper, published in NATURE, vol. xxiii. p. 195, will, if adopted without further examination, even temporarily, exercise an unfortunate influence upon the present attempts to rid the atmosphere of our large towns of their ever-recurring fogs, glooms, and mists, and those conclusions certainly are not supported by such evidence as we already have as to the production of fogs on a great scale, however much indicated by experiments in the laboratory. It is stated that, "It having been also shown that all forms of combustion, perfect and imperfect, are producers of fog nuclei, it is concluded that it is hopeless to expect that, adopting more perfect forms of combustion than those at present in use, we shall thereby diminish the frequency, persistency, or density of our town fogs." Now, first as to frequency: what are the facts with regard to localities differing in their methods or materials for producing heat? Every one living in or near London knows that fogs, thick mists, and dark days are far more frequent within than without its circumference, and experiment has shown that sunshine is both less frequent and much less intense within the metropolis. And, according to Mr. Aitken's theory, something of the same kind ought to be observed wherever large quantities of fuel are burned, whether smokeless or not. Thus, the large towns of the Continent, where wood and charcoal are in general use, would have their peculiar urban fogs. But they are free from any fogs beyond those which are common to the country. And Paris, before coal was much used, ought to have been distinguished by more frequent fogs than the surrounding country. But it was not so marked out. No oasis of fog prevailed there when the sun shone brightly beyond its precincts, as in our own capital. And Philadelphia, which burns

anthracite, ought not to rejoice in a pure and transparent atmosphere.

Similarly, the South Wales coal and iron districts would be centres of fog clouds and mist, like Birmingham and Newcastle. But they are as free from fog as the purely pastoral valleys of Wales.

Next, as to persistency Early in the morning of January 31 last, in some districts of London the fog extended considerably above the tops of the houses, in others only about 10 or 20 feet from the ground in any intensity. Where the fog extended high the smoke mixed with it and produced a yellow fog, but where it remained low the smoke escaped into the upper air and drifted away, leaving a white fog below, so pure as to be a very unusual phenomenon at 10 a m in a London street Now it was remarkable, that wherever the white fog prevailed in the morning, the sun soon obtained the mastery and dispelled it more or less, but in the smoke obscured districts a dark yellow fog continued throughout the day

White fogs may doubtless be exceedingly dense But will not an admixture of smoke increase its density?

A humid atmosphere is not necessary for the production of mist and haze. The frequent long-continued prevalence of blue haze over the whole country, not excepting the east coasts, in the driest east winds of spring, would be a subject deserving investigation They sometimes extend to a height much above the tops of our highest mountains Experiments such as those of Mr Aitken will, we may hope, ultimately solve this problem of meteorology. R RUSSELL

Low Temperature

THE reading of the thermometer here last night, January 15, 16, was the lowest ever recorded at this observatory in the course of thirty three years The reading was 4°6 F, the previous minimum having occurred on December 24, 1860, when the mercury stood at 6° 7 F. S J PERRY

Stonyhurst Observatory, January 16

A "Natural" Experiment in Polarised Light

BREAK off a plate of ice and hold it between the sky and a pool of water. Its reflected image will show the beautiful colours due to polarised light The incident rays should come from a part of the sky about 90° from the sun, and reflection should take place at the polarising angle for water, and the plate will probably require adjusting to bring out the maximum effect Water, vaporous, solid, and liquid, thus furnishes us with polariser, crystal, and analyser I do not remember to have read any account of this very simple experiment, for which Nature provides all the materials. CHAS I. WHITMELL

9, Beech Grove, Harrogate, January 10

STATICS AND DYNAMICS OF SKATING

MANY years ago, when skating was but in its infancy, skates were made of bone, and if they could be made to stay on the feet they were considered to answer their purpose sufficiently well

More recently iron runners with wooden beds came into use, and accuracy of adjustment on the foot, horizontally and longitudinally, was made easier by means of leather straps and a screw passing into the heel of the boot, and these adjustments, made haphazard, were quite sufficient for the skating of those days, namely forward skating

Within the last twenty years however skating has made enormous strides, back skating becoming an essential qualification of a finished skater, and hence not only more perfect forms of skate are demanded from the maker, but also the adjustment of them on the boot becomes an important part of his duty.

There are three points to be attended to in the adjustment of the skate, besides the obvious one of placing the skate medially on the foot.

1 Height of foot off the ice where the greatest breadth of the sole of boot occurs

2 Height of foot off ice at the heel

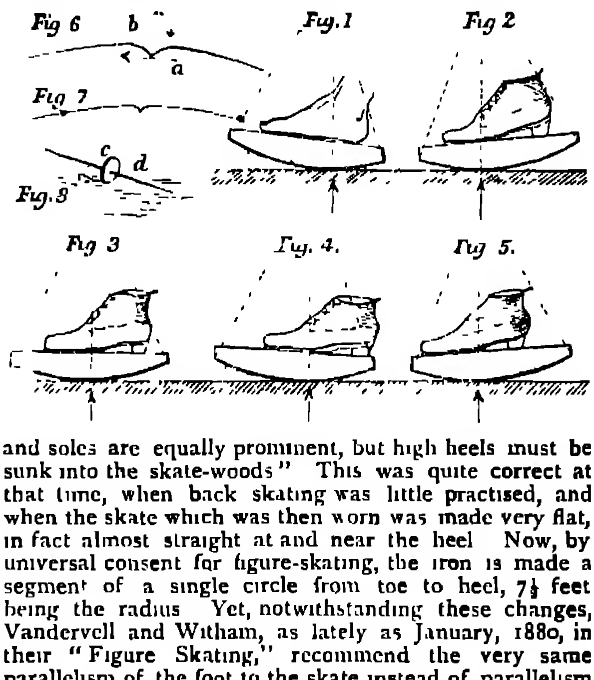
3 Position of the skate longitudinally or lengthwise on the foot

First. The height of the foot from the ice should be such as will enable the skater to lean over sufficiently when on a curve, and such that he may be able to get a powerful enough stroke If he is too low the edge of the boot will come in contact with the ice in leaning over and also in taking a stroke, a fall ensuing in the first case, and a disagreeable and dangerous overstrain in the second To avoid these the sole of the boot should subtend an angle at the bottom of the runner of about 96 deg *i e* for a sole 3½ inches broad the edge of the runner should be 1½ inch from the sole, instead of varying from 1⅞ to 1⅛ inch, which are the heights of skates commonly met with

This angle of 96 deg will be found to clear the ice in both striking and leaning over for most skaters, and any greater height than is given by this angle should not be used, as it is not necessary, and only throws an additional strain on the ankle

Second The height at the sole having been fixed, the next point is what should be the height at the heel? In fact is the foot to be parallel to the skate, or is it to rest on an incline?

Dove was the first person, in his "Skater's Monitor," published in Edinburgh in 1846, to write on the position of the skate on the foot, summing up his remarks by saying, "Level woods then are for shoes whose heels



and soles are equally prominent, but high heels must be sunk into the skate-woods" This was quite correct at that time, when back skating was little practised, and when the skate which was then worn was made very flat, in fact almost straight at and near the heel Now, by universal consent for figure-skating, the iron is made a segment of a single circle from toe to heel, 7½ feet being the radius Yet, notwithstanding these changes, Vandervell and Witham, as lately as January, 1880, in their "Figure Skating," recommend the very same parallelism of the foot to the skate instead of parallelism of the top of the blade to the ice, as it should be for modern skating, as I shall subsequently show

In Fig 1 is shown the result of adopting Dove's or Vandervell and Witham's position, *i e* no heel It might be thought that a person standing on a curve would balance comfortably at the middle of the curve, but this cannot be, for a person standing naturally on a level surface does not distribute the weight of his body equally over the length of his foot, but by far the greater part comes on the heel, and therefore the centre of pressure of his body is nearer the heel than the toe, and consequently if he is standing on a curve the curve must roll up in front and down behind till the upward pressure of the ice just passes through the centre of pressure of his body The point of contact of the skate on the ice will therefore not only be much behind the centre of the skate, but will be a little behind the centre of pressure of his body when standing on a level surface, as he now

rests on an incline Of course the footstocks of the skates being too low behind would produce the same effect as too low a heel to the boot, *i.e.* throw the balance too far back

Fig. 2 shows the position the skate will have on the ice if the heel is too high, *i e* the centre of pressure is thrown too far forward, and consequently the skate must roll up behind in order to get the proper balance

In Fig 3 is shown a skate in the proper position on the ice, *i.e* with the heel raised so high as to throw the centre of pressure on the centre of the foot and skate

The proper height of the heel of the boot to obtain this result will depend on whether the footstocks of the skates are level, as they ought to be, and the exact height will vary with different individuals, depending on whether they naturally stoop or lean well back, and probably also on the boots they are in the habit of walking in, and therefore can only be determined accurately by trial, but a half-inch heel is by no means too low for most persons

Third With regard to the adjustment of the skate longitudinally, Figs 4 and 5 will show the obvious effects of not fixing the skate properly on the foot, in Fig 4 the skate being put too far forward, and in Fig 5 too far back

Having now shown how to procure the balance on any desired part of the skate, it only remains to be shown why the position of the skate, with the balance on the centre as in Fig 3, is the proper one, and as the effects of the various positions are most evident in skating turns, I shall confine myself entirely to them, commencing by giving the theory of turns, which I believe has never been satisfactorily explained

It is impossible in a few words to describe accurately and fully the forces which come into action in making a turn, but my object will be attained by describing what I consider the basis of the whole theory of turns, namely, that a turn is not a twist round of the body made by the skater at the moment of the turn, but the turning round of the body is the result of a reaction of the ice on the skater caused by his putting his skate (by rolling on to the toe or heel) in such a position as to make that part of the skate bite or grip the ice, producing a force opposite, though not directly opposed, to his direction of motion, but parallel to it The direction of this reaction is shown by the arrow *a* in Fig 6, and being exerted at some distance from the body, it necessarily tends to turn the body round in the direction of the arrow *b* It will be evident that the greater the distance of the point of application of this force from the curve the skater is describing, the greater will be the *couple* tending to turn round the body

This action can be shown by means of a disk of lead *c*, in Fig 8, with a light rod through it If this be made to roll on a table, and a force be applied to the rod at *d* by means of the finger, the action of reversing the body and preserving the same inclination will be distinctly shown Suppose the skater then about to make a back turn, and that he balances near the heel of his skate as in Dove's plan, then, as he can only roll a very little further back, as he is already on the heel of his skate, the leverage, and hence the couple tending to turn him round, will be almost *nil*, the cusp he makes being of the shape shown in Fig 7, instead of being of the shape shown in Fig 6, and consequently if he is to turn round in time he must give his body a wrench round, which is of course very inelegant, and very difficult to accomplish. If the balance is on the heel the cusps of the forward turns are much larger than the cusps of the back turns, thereby tending to make the back turns more difficult than is necessary, but even with the balance on the centre of the skate back turns will be more difficult than forward turns, as the formation of our bodies prevents the bending up of the foot more than a few degrees, even with a boot off, whereas we can bend it down 40 deg easily

With the balance on the centre of the skate back turns can be performed without any wrench or swing of the leg—a thing that is physically impossible if the balance is on the heel, as it must be in Dove's or Vandervell and Witham's plan. CHARLES ALEX STEVENSON

JOHN DUNCAN THE ALFORD WEAVER AND BOTANIST

ON the last day of 1880 the University of Aberdeen was presented with a herbarium of 1131 specimens of the British Flora, gathered, preserved, named, and localised by an aged country weaver who lives near Alford in Aberdeenshire He is no ordinary man, as the accumulation of such a botanical collection is alone sufficient to prove It represents a portion only of the scientific labours of nearly fifty years --for much of these have been destroyed by time and the moth This remarkable man, who is now a pauper on the parish which has been the scene of his unextinguishable scientific enthusiasm, should be better known to the scientific world, and a short sketch of his life and labours may not be unacceptable to the readers of NATURE.

John Duncan was born on December 24, 1794, so that he is now in his eighty-seventh year His parents were very poor, and could afford him only the merest rudiments of even the three R's as then taught, for his education had to be sacrificed to the pressure of penury He learnt to read by laboriously spelling his way through the text in church, his writing has ever been very rude, but distinct, and his spelling is such an example of the phonetic as would delight Mr Pitman He was early sent to work and became a "customer weaver," making into cloth the flax and wool sent to his home by his neighbours, and such he has remained ever since He married early in life, and had a son and two daughters, but his wife died more than thirty years ago, and all his family have gone, he remaining as the sole survivor During the greater part of his long life he has dwelt in the valley of the Don, near Alford, and for nearly thirty years in the same cottage at Droghsburn, in the pleasant hollow of the Leochel, five miles above that village This cottage forms one end of a line of dwellings, the other belonging to a ditcher's family who prepare his simple meals He occupies a single room, filled with the looms and other implements of his trade, open to the thatched roof, his bed resting on some deals laid across the rafters, and reached by means of a ladder In this narrow space John Duncan has lived for twenty-eight years, a solitary man, in serene contentment, upright and religious, working laboriously for an honest living, cheered only by the friendship of a few, his love of books and his devotion to the study of plants, which he has prosecuted with a single-minded enthusiasm that is as rare as it is beautiful. I visited him about three years ago and spent two days in his company, having long wished to do so from what I had heard of him from his dearest friend and fellow student, Charles Black I found him in good health, working hard at his craft with sturdy and admirable independence, visited only by a few disciples whom he had inspired with a love of himself and the plants, unknown, self-contained, and happy even on the verge of want I examined his plants, talked of their history and the crowding memories they recalled of countless wanderings in their search saw his books on botany, theology, and general literature, which are unusually numerous and costly for a poor man, conversed with him on many subjects, chiefly connected with his studies, and his intimacy with Charles, whose friendship is now the chief comfort of his age, and I left him charmed, inspired and rebuked by his life, character, enthusiasm and wise contentment, the result of unwearied devotion to higher pursuits

Some interest in the solitary student was roused by an

account I then gave of him. This account appeared in *Good Words* for April, May, and June, 1878, with pictures of himself and his cottage. It has recently been incorporated in whole into "Leaders of Men," by H. A. Page (Marshall, Japp, and Co., London), and he was visited by not a few kindly spirits whose open-handedness lightened somewhat the growing pressure of age and want. Since then he has worked at his loom, winning his daily bread with heroic struggle, till a short time ago, when decaying power and some paralytic touches, in his eighty-sixth year, compelled him reluctantly to give it up and remove from his small but honourable workshop and study to be kindly tended by the ditcher's widow. Many years ago his hard-won earnings—for he was always a most careful man—were dissipated through domestic causes over which he had no control, attended with heavy griefs. Since then his growing age has barely enabled him to live more than from hand to mouth, and now for some time he has had to do what must be inexpressibly keen to an independent soul like his, to accept from the parish a pauper's portion.

From his earliest days, when he used to play upon the green cliffs of the high conglomerate coast of Kincardine, John Duncan had an intense love of plants, and long before he began their scientific study collected them for their medicinal uses, guided by Culpepper's "Herbal." It was not till he was forty years of age, when he was introduced in 1835 to Charles Black, that he commenced the study of botany as a science. Charles was a remarkable man, of great individuality and ability, and though twenty years his junior, at once gained over him an ascendency of the best kind, and inspired him with an ardent friendship that has been the sweetest solace of his long solitude. He still lives as the gardener he was then, a botanist, geologist, ornithologist, numismatist, scientific student, theologian, and omnivorous reader at Arbigland in Dumfries, near the mouth of the Nith. When these two men met, Charles was settled as gardener near Alford, and under his guidance John at once began the systematic study of botany. They soon conquered the flora of the Vale of Alford, the curious peak of Ben-a-chie, where they found at an early date the *Rubus chamæmorus*, or cloudberry, being a favourite haunt. John, having his time, as a home weaver, more at his own command, by and by extended his excursions to greater distances, and before very long did the most of the county. The enthusiasm with which these two humble men prosecuted their studies was wonderful, the morning light often surprising them at their work of classifying, drying, and arranging their accumulating treasures. The want of text-books of the science was sorely felt by them, and excited them to ingenious devices to supply it; a certain country inn, for example, being frequented by them, not for convivial purposes, but to obtain a sight of "Hooker," which had belonged to the innkeeper's dead son. The details of John's continued studies under poverty, difficulty, and trial are interesting and honourable, but these cannot be given here. In order to extend his knowledge of botany and the flora of Scotland he used to take harvest work in different parts of the country, studying in succession the plants of each district, till he had in this way traversed the most of the land from Northumberland to Banff, except some parts of the West and the Highlands; bringing home specimens living and dead, planting the one in his own neighbourhood, and adding the other to his rapidly-increasing herbarium. His knowledge of plants was minute and scientific, and the abundant technical terms were used with ease and intelligently understood by the help of a Latin dictionary he had purchased for the purpose; nor was it confined to mere technicalities, but extended to an unusual acquaintance with their habits, history, and uses. His collection of botanical works is surprisingly large and valuable, all purchased by his own hard-won earnings. His memory being as strong as his use of the pen was weak, he did not write down any details of the plants thus collected, but he could tell all these when asked with unerring precision, as well as relate the varied incidents, interesting, humorous, happy or hard, connected with their discovery. The names and localities have however been successfully obtained from him and written down, by the help of one of his disciples, Mr. J. M. B. Taylor, of Aberdeen, who prepared the herbarium for the University.

John kept his collection neatly laid down in volumes made by himself of newspapers of the period, of tea paper, which he thought a good protection against moths, and of other homely materials scented with camphor. Many of them of course decayed or were destroyed during the forty and more years they were in his possession, but even after discarding all imperfect specimens there remained 1131 plants now fully named, localised, and arranged by Mr. Taylor from John's unfailing memory. They are divided in four books, put together by John himself.

1. A general collection of some 500 specimens including ferns arranged according to the Linnæan system, 100 of which are described by Prof. Dickie, author of the "Flora of Aberdeen, Banff, and Kincardine," as rare or very rare.

2. An almost perfect collection of the flora of the Vale of Alford, many of the plants now uncommon.

3. Specimens of about 50 of the grasses from the Alford district.

4. Specimens of some 50 of the Cryptogamia of the district, chiefly mosses and lichens.

John never possessed above a few of *the very rarest* of our British plants, not having visited the higher mountains and outlying regions where only such are found, but had been fortunate in obtaining a large number of local and very local, rare and very rare species. They were mainly found along the eastern half of the country from Banff to Northumberland, excluding the Highlands.

Such is a very slight sketch of the life and labours of this remarkable weaver. The presentation of his herbarium has revealed the sad fact that, independent and toil-worn as he has ever been, even to nigh eighty-six, he has been lately compelled to bear the pain and shame of depending on the parish for his daily bread. His books are of value, and would alone fetch a considerable sum, but these, the dear companions of his life, he cannot bring himself to part with, though now unable to enjoy more than a sight of them. His beloved plants he would not barter for heaps of gold, and he has therefore presented them to Aberdeen University, there, it is to be hoped, not only to do good educational work, but to exercise an inspiring impulse over many generations of students privileged to examine these far-fetched treasures.

An appeal has recently been publicly made in favour of the aged botanist, to enable him to spend his few remaining days in comfort and independence, supported by the free-will offerings of the scientific and generous, which have been amply won by scientific work admirably achieved. Scientific societies throughout the country could not better aid research than by recognising his merit, and making a contribution for such a worthy object. Shortly after my account of him in *Good Words* the Largo Field Naturalists' Club elected John an Honorary Member, and the same has been recently done by the Inverness Scientific Society and Field Club, which also made a donation to him of 5*l.*, examples that might be honourably followed by other societies. A lively interest has been excited in his case, and has been already substantially expressed. It is devoutly to be hoped that such a man will not be allowed to go down to his grave dishonoured and neglected.[1]

WILLIAM JOLLY

[1] Subscriptions may be sent to William Jolly, H.M. Inspector of Schools, Inverness.

THE INDO-CHINESE AND OCEANIC RACES—TYPES AND AFFINITIES[1]

IV.

HERE are the Raja of Gorontalo, N. Celêbes (Fig. 22), the chief of Sendegeassi, S. Nias, West Coast Sumatra (Fig. 23), and two natives of Jilolo (Fig. 24), all supposed to be more or less typical Malays whom it will be profitable to compare with Figs. 19, 20, 21, representing the Caucasian pre-Malay or Indonesian element in the Archipelago. In Fig. 25 we have Mohamed-Yamalal-Alam, Sultan of the Sulu Archipelago who was compelled to accept Spanish supremacy in 1876. He is a pure Malay about thirty-four years old, like most of his subjects presenting a fine type far superior to that of the Malays of Malacca. Yet the Mongoloid element is unmistakably betrayed, especially in the high cheek-bones, presenting such a striking contrast to the regular European features of the Indonesians (see Figs. 19, 20, and 21). The portrait is from a photograph forwarded to France by MM. Montano and Rey, and originally published in *La Nature*, April 3, 1880.

But if we must speak with great hesitation and much reserve of a common Malay type, we can speak all the more confidently not only of a common Malay speech, but of a common "Malayo-Polynesian," and even of a common Indo-Pacific speech. Indeed the chief objection to the linguistic expression Malayo-Polynesian is that it is no longer sufficiently comprehensive. In the alternative Indo-Pacific, which, on the analogy of Indo-European, I have proposed as a substitute, the first component must be taken in two senses, so as to include both the Indian Ocean and a portion of Further India. When Fr. Muller wrote: "So much remains certain, and will never by the most brilliant and cogent reasonings be disproved: the Malayo-Polynesians are connected with no Asiatic people," he had in his mind not so much the "Malayo-Polynesian race" as the Malayo-Polynesian language. In this sense the statement was true enough according to his lights. In common with other eminent philologists he entirely overlooked Cambojan, or from insufficient data probably regarded it as a monosyllabic-toned language allied to the Indo-Chinese family. He consequently considered it as fundamentally distinct from the Malayo-Polynesian group, which is admittedly polysyllabic and untoned. But we have already seen in Section IV. that Cambojan or Khmêr is not a member of the Indo-Chinese family, and that it is polysyllabic and untoned, like all other known forms of speech. In the above-quoted paper "On the Indo-Chinese and Inter-Oceanic Races and Languages" (pp. 15-22) I further show that the true affinities of Khmêr are with the Malayo-Polynesian tongues, the whole forming a vast linguistic family stretching from Madagascar to Easter Island, west and east, from Hawaii to New Zealand, north and south, and with its basis still resting on the Indo-Chinese peninsula, where it originated, and whence it has been diffused throughout the Oceanic area with the migrations of the Mongolo-Caucasian races. Here it has long reigned supreme, continually encroaching upon and surrounding, as in so many detached enclaves, the diverse Negrito and Papûan tongues, but itself now threatened with extinction by the advancing Siamese and Annamese on the mainland, and by the still more aggressive English in Polynesia.

All the arguments establishing the intimate connection of the Cambojan and Malayan languages need not be repeated; but that based on the principle of modifying infixes has attracted so much attention, and is in itself so interesting, that the readers of NATURE will perhaps be glad to have it here resumed:—

"Common to the Khmêr and Malaysian tongues is one feature so peculiarly distinctive as of itself alone almost sufficient to establish their common origin. This is the use of identical infixes, which, though forming a marked characteristic of Khmêr, Malay, Javanese, Tagala, Malagasy, and other members of this group, has not yet been generally recognised. . The infixes in question are always the same, the liquids *m* and *n*, and even *mn*, with or without the connecting vowels *a*, *o* with *m*; *a*, *i* with *n*. Thus:—

IN KHMÊR: *m, am, om, mn, n*.

Slap, dead; samlap, to kill.
Sruoch, pointed; samruoch, to point.
Thleak, to fall; tomleak, to throw down.
Rolôm, to fall; romlom, to knock down.
Chereap, to know; chumreap, to show, teach, make known.
Kur, to draw; Komnur, a design.
Srek, to cry; samrek, a shout.
Chêk, to share; chamnek, a part or portion.
Sauk, to corrupt; samnauk, a bribe.
Pram, to publish; bamram, a notice.
Pang, to wish; bamnang, a wish.
Rep, to confiscate; rombep, seizure, thing seized.
Ar, to saw; Anar, a saw.

IN MALAGASY: *in, om*.

Hanina, food; homana, to eat.
Tady, twisted, a rope; tamady, strong.
Taratra, glaring; tomaratra, transparent.
Safotra, overflown; somafotra, brimful.
Sany, likeness; somany, like.
Safy, spying; somafy, sight of distant object.
Vidy and vinidy, bought.
Vaky and vinaky, broken.

IN MALAYSIAN: *um, âm, in*.

Javanese.

Rayah, to bereave; rinaya, to be bereft.
Hurub, flame; humurub, to flame.
Balinbin, a small fruit; binalinbin, a round gem.

Tagala.

Basa, to read; bumasa, to make use of reading.
Kapatir, brother; kinapatir, brotherly.
Tapay, to knead; tinapay, bread.
Guntin, shears; gumuntin, to cut with shears.

Malay.

Palu, to beat; pâmalu, a club.
Pukul, to strike; pâmukul, a hammer.
Sipit, to grasp; sinipit, an anchor.
Padam, to extinguish; pâmadam, an extinguisher.
Pilih, to choose; pâmilihan, choice" (pp. 20-1).

This characteristic, of which nothing but the faintest echoes occur in any other linguistic system, is obviously one that is incapable of being borrowed, as prefixes and suffixes may occasionally be borrowed. Hence it must be regarded as an organic principle developed in the primitive speech before its differentiation into the various Oceanic branches, whose common origin seems thus to be established beyond question. The theory of such a remarkable feature being evolved independently at several points in this linguistic area and in no other cannot be seriously entertained.

Here therefore we have one type of speech everywhere common to two racial types, and the question arises, how all the Malayan peoples have come to speak exclusively polysyllabic untoned tongues, while their nearest kindred, the Mongoloid peoples of Indo-China, still speak exclusively monosyllabic toned languages. To explain this phenomenon we must remember that, as already pointed out, the polysyllabic-speaking Caucasians preceded the monosyllabic-speaking Mongols both in Farther India and in the Archipelago. Hence when the Mongols quitted the mainland they found the islands occupied by the Caucasians, with whom they amalgamated, and whose speech they adopted. Similar instances, though perhaps not on such a large scale, have occurred often enough elsewhere, even in historic times. Thus the Mongolo-Tatar Aimaks and Hazaras of North Afghanistan all now speak

[1] Continued from p. 251.

Persian; the Ugro-Finnic Bulgarians have been Slavonised in speech since the tenth century; the Northmen of the Lower Seine valley entirely forgot their Norse tongue within two generations, and many of the early English settlers in Ireland rapidly became "Hiberniores ipsis Hibernicis," more Irish than the "Irishry" themselves. Special causes, arising from the utterly antagonistic nature of toned and untoned languages, must have accele-

FIG. 22.—Malayan Type, Celebes. King of Gorontalo.

rated the process of assimilation in Malaysia, where nevertheless its universality still remains a remarkable circumstance. For it is undoubtedly surprising that not a single Malay community should have succeeded in retaining its original monosyllabic speech, and still more surprising to find that every trace of monosyllabism had already disappeared, at least from Java, Madura, and Bali some two thousand years ago. The old Kawi language current in those islands and reduced to writing by the Buddhists at that remote period is as genuine a polysyllabic tongue as its modern representatives, Javanese, Sundanese, Madurese, and Balinese.

The eastern or Sawaiori branch differs greatly from the

FIG. 23.—Malayan Type, Sumatra. Chief of Sendegrassi, Nias Island.

western or Malaysian, with which it has now really little in common beyond the fundamental elements. But these, after a separation of probably many thousand years, are still numerous enough to establish beyond all doubt their primeval unity. In this instance, however, as in so

FIG. 24.—Malayan Types, Jilolo. Mother and Daughter, Dodinga.

many others, community of speech in no way involves community of descent, for we have just seen that the language now spoken by the Malay races was in all probability imposed upon them by their Caucasian predecessors in the Archipelago. On the other hand there is no reason to suppose that the Eastern Polynesians ever spoke any other than their present language, its resemblance to the Malay being due not to their relationship with the Malay people, but with the Indonesian Caucasians, from whom the Malays borrowed their speech.

Like the other members of the family Sawaiori is agglutinating, but it occupies a very primitive or undeveloped position in that order of speech. Thus it betrays very slight traces of the infix principle, but it possesses as a prefix the same particle *ma*, which in Cambojan and its Malaysian congeners appears as an infix. In Samoan, for instance, *fai* = to do, but *mafai* = to be able, *sasa'a* = to spill, *masa'a* = spilt; *lilgi* = to pour out, *maligi* = to be poured out; *fasi* = to split, *mafasi* = to be split off, *fati* = to break, *mafati* = to be easily broken, *fola* = to spread out, *mafola* = to be spread out, *gaegae* = to shake, *māgaegae* = to be loose; *goto* = to sink, *magoto* = to be sunk or waterlogged, and so on, generally in an intransitive or passive sense.

But the chief peculiarity of the Sawaiori tongues is their extremely simple phonetic system, comprising no more than fifteen letters (five vowels and ten consonants), with no closed syllables or combinations of two or more consonants without an intervening vowel. Hence the strange forms assumed by English and other European words in the mouths of the natives. When he visited Tahiti in 1769 to observe the transit of Venus, Cook tells us that "after great pains they found it utterly impossible to teach the Indians to pronounce their names . . They called Capt. Cook, Toote, Mr. Hicks, Hete, Molineux they renounced in absolute despair, and called the master Boba, from his Christian name Robert, Mr. Gore was Toarro, Dr. Solander, Torano, and Mr. Banks, Tapane, Mr. Green, Eteree, Mr. Parkinson Patini, Mr. Sporing, Polini; Petersgill, Petcrodero, and in this manner they had now formed names for almost every man in the ship" (*First Voyage*)

To resume: in the Indo-Chinese and Oceanic regions we have altogether five distinct types—three dark (Negrito, Papûan, and Austral, with the doubtful Tasmanian), one yellow (Mongolian), and one brown (Caucasian). These, with their various ramifications and interminglings, give the seven main divisions of our scheme, which may now be expanded and complemented as under. Here, for reasons fully specified, the familiar term "Malayo-Polynesian" disappears, and Malay itself sinks to the position of a variety of the Mongolian type. Although grouped with the Oceanic brânch of this division, it should be noted that the Malays also occupy most of the peninsula of Malacca. But they seem to be intruders in this region, the true aborigines of which are the Negrito Samangs, and in any case their real home in historic times is the Eastern Archipelago.

A.—DARK TYPES

I. NEGRITO.—Aetas of the Philippines, Andamanese Islanders, Samangs of Malacca, Kalangs of Java Karons of New Guinea.

II. PAPÛAN.—1. *Central Branch*. Papûans proper of New Guinea and adjacent islands, Mafors, Arfaks, Koiari, Koitapu, Waigiu, Aru, Salwatty, Mysol, Gebi, &c. 2. *Eastern Branch*. Sub-Papûans East (Melanesians), Admiralty, Louisiade, New Britain, New Ireland, Solomon Islands, New Hebrides, Loyalty, New Caledonia, Fiji. 3. *Western Branch*. Sub-Papûan, West ("Alfuros")· Flores, Ceram, Buru, Timor, Parts of Gilolo, Banda, Kissa, Savu, &c.

III. AUSTRAL.—Australians, Tasmanians (?).

B.—CAUCASIAN TYPES (Fair and Brown)

IV. CONTINENTAL BRANCH.—Khmér or Cambojan Group: Khmers proper, Khmêrdom, Charay, Stieng, Cham, Banhar, Xong, Khang, &c.

V. OCEANIC BRANCH.—Indonesian Group. Battas of Sumatra, Dyaks of Borneo and Celebes, some "Alfuros" of Ceram and Gilolo, Mentawey Islanders. Sawaiori or Eastern Polynesian Group. Samoa, Tonga, Tahiti, Marquesas, Tuamotu, Maori, Hawaii, Tokelau, Ellice.

FIG. 25.—Malayan Type, Sulu Islands. The present Sultan of Sulu

C.—MONGOLIAN TYPES (Yellow and Olive Brown)

VI. CONTINENTAL BRANCH.—Indo-Chinese Group. Chinese, Annamese, Tibeto-Burmese, Thai (Siamese, Laos, Shan, Khamti), Khasia, Khyen, Karen, Kuki, Naga, Ahom, Mishmi, Bhod.

VII. OCEANIC BRANCH.—Malayan Group. Malays Proper, Javanese, Sundanese, Madurese, Balinese, Macassar, Bugi; Malagasy of Madagascar, Tagalo-Bisayans of Philippines, Formosan Islanders, Mikronesians (Pelew, Carolines, Ladrones, Marshall, Gilbert Islands.)

It thus appears that the three great divisions of mankind (A, B and C) are in possession of an ethnical region which some anthropologists have regarded as the

cradle of the human race. Observing that the anthropoid apes of equatorial Africa—gorilla and chimpanzee—are dolichocephalous, while those of Malaysia—orang-utan and gibbon—are brachycephalous, certain polygenists have suggested that the former may be the progenitors of the dolichocephalous Negroes, the latter of the brachycephalous Negritos. But we have seen that the Papûans of the extreme east (New Hebrides, Fiji, &c) are also dolichocephalous, and even of a more pronounced type than the natives of Sudan On the other hand, the Obongos, Akkas, and other pigmy tribes of Central Africa appear to be brachycephalous,[1] so that the theory fails at both extremes, Fiji and the Gaboon Assuming however that mankind may have been evolved in the Eastern Archipelago or in some now submerged adjacent lands, and bearing in mind the relative value attached to the idea of race, as implied in our definition of species, the present conditions might still admit of explanation. In the Andamanese Islanders, whom Prof Flower justly regards as of an "infantile type," and in the Javanese Kalong, whose features von Rosenberg describes as the most decidedly ape-like he had ever seen, we would have still *in situ* the earliest extant representatives of primeval man. Migrating westwards across a now lost "Lemuria," this primitive Negrito race may have reached equatorial Africa, where it is still represented by Du Chaillu's Obongo, Lenz's Abongo or Akoa, Schweinfurth's Akka, and where it may under more favourable conditions have become differentiated into the Negro of Sudan Migrating eastwards across a continent of which the South Sea Islands are a remnant, the same Negritos may have similarly become slowly differentiated into the present Papûan or Melanesian peoples of those islands. Migrating northwards, before the severance of the Archipelago from the mainland, they reached Malacca and the Deccan, where they may still be represented by the Maravans and other low castes of that region Moving thence over the Asiatic continent, they became under more temperate climes differentiated, first probably into the yellow Mongol, and then through it into the fair Caucasian type But however this be, the subsequent migrations of the Mongols and Caucasians to the Archipelago, as above set forth, was probably, after all, but a return under new forms to their old homes. Here their mutual interminglings have again evolved fresh types and sub-types, producing a chaos of races whose true affinities I have endeavoured in these papers to elucidate, while fully sensible that in all such inquiries the last word still must be, *felix qui potuit rerum cognoscere causas*

A H KEANE

THE PHOTOPHONE

THE following calculation, made with the view of examining whether the remarkable phenomena recently discovered by Prof Bell could be explained on recognised principles may interest the readers of NATURE. I refer to the *un-electrical* sounds produced by the simple impact of intermittent radiation upon thin plates of various substances.

It has been thought by some that in order that a body exposed to variable radiation may experience a sensible fluctuation of temperature its rate of cooling must be rapid. This however is a mistake. The variable radiation may be divided into two parts—a constant part, and a periodic part—and each of these act independently. Under the influence of the constant part the temperature of the body will rise until the loss of heat by radiation and conduction balances the steady inflow; but this is not appreciable by the ear, and may for the present purpose be left out of account. The question is as to what is the effect of the periodic part of the whole radiation, that is, of a periodic communication and *abstraction* of heat which leaves the mean temperature unaltered. It is not difficult to see that if the radiating power of the body were sufficiently high, the resulting fluctuation of temperature would diminish to any extent, and that what is wanted in order to obtain a considerable fluctuation of temperature is a *slow* rate of cooling in consequence of radiation or convection.

If θ denote the temperature at time t, reckoned from the mean temperature as zero, q be the rate of cooling, $E \cos pt$ the measure of the heating effect of the incident radiation, the equation regulating the fluctuation of temperature is—

$$\frac{d\theta}{dt} + q\theta = E \cos pt.$$

Thus—

$$\theta = \frac{E \cos (pt + \epsilon)}{\sqrt{(p^2 + q^2)}},$$

showing that if p and E be given, θ varies most when $q = 0$

Let us suppose now that intermittent sunlight falls upon a plate of solid matter If the plate be transparent, or absorb only a small fraction of the radiation, little sonorous effect will be produced, not merely because the radiation transmitted is lost, but because the heating due to the remainder is nearly uniform throughout the substance In order that the plate may bend, as great a difference of temperature as possible must be established between its sides, and for this purpose the radiation should be absorbed within a distance of the order of half the thickness of the plate If the absorption be still more rapid, it would appear that the thickness of the plate may be diminished with advantage, unless heat conduction in the plate itself interferes. The numerical calculation relates to a plate of iron of thickness d It is supposed that q is negligible in comparison with p, *i e* that no sensible gain or loss of heat occurs in the period of the intermittence, due to the fluctuations of temperature themselves.

If the posterior surface remains unextended the extension of the anterior surface corresponding to a curvature ρ^{-1} is $\frac{d}{\rho}$, and the average extension is $\frac{d}{2\rho}$ Let us inquire what degree of curvature will be produced by the absorption of sunlight during a time t, on the supposition that the absorption is distributed throughout the substance of the plate, so as to give the right proportional extension to every stratum.

If Ht denote the heat received in time t per unit area, c the specific heat of the material per unit volume, e the linear extension of the material per degree centigrade, then

$$\frac{1}{\rho} = \frac{2eHt}{c \cdot d^2}$$

In the case of sunshine, which is said to be capable of melting 100 feet of ice per annum, we have approximately in $C.G.S$ measure

$$Ht = \cdot 008\, t.$$

Thus $$\frac{1}{\rho} = .016 \frac{et}{cd^2}$$

For iron $e = \cdot 000012$, $c = 86$.

Thus if $t = \frac{1}{n}$ (of a second), $d = \cdot 02$ cents.

$$\frac{1}{\rho} = 1 \cdot 12 \times 10^{-6}.$$

This estimate will apply roughly to a period of intermittence equal to $\frac{1}{500}$th of a second, *i e* to about the middle of the musical scale If the plate be a disk of radius r, held at the circumference, the displacement at

[1] The Akkas certainly, but Lenz seems to think that the Abongos are dolichocephalous, so that this point remains still to be settled Dr Barnard Davis however in his *Thesaurus Craniorum* recognises brachycephaly in equatorial Africa, four out of eighteen skulls in his collection from this region being distinctly brachycephalous

the centre will be $\frac{r^2}{2\rho}$, or $\cdot 56\, r^2 \times 10^{-6}$. In the case of a diameter of 6 centimetres this becomes $5 \cdot 0 \times 10^{-6}$.

Five-millionths of a centimetre is certainly a small amplitude, but it is probable that the sound would be audible. In an experiment (made, it is true, at a higher pitch) I found sound audible whose amplitude was less than a ten-millionth of a centimetre.[1] We may conclude, I think, that there is at present no reason for discarding the obvious explanation that the sounds in question are due to the bending of the plates under unequal heating.

January 13 RAYLEIGH

[1] *Proc.* Roy. Soc. 1877.

NOTES

WE regret to learn of the death of the Rev. Humphrey Lloyd, D.D., Provost of Trinity College, Dublin, on the 17th inst., at the age of eighty-one years. Dr. Lloyd's contributions to scientific literature have been many and important, and to these and to his career generally we hope to refer at length in our next number.

PROF. HUXLEY has been appointed to the Inspectorship of Fisheries vacant by the death of Mr. Frank Buckland.

THE Queen has been pleased to confer a pension of 200*l.* upon Mr. Alfred Russel Wallace.

THE election of Dr. B. A. Gould of Cordoba in the place of the late Prof. C. A. F. Peters, director of the Observatory at Kiel, as Correspondent of the Academy of Sciences at Paris, completes the authorised number in the section of Astronomy.

YORK has already begun to make preparations for the 51st meeting of the British Association in that city on August 31 next. A meeting is to be held on the 26th inst. to appoint a reception committee and take other steps in connection with the approaching visit of the Association. The local secretaries are the Rev. Thomas Adams and Dr. Tempest Anderson.

THE well-known collection of fossils formed by the late Mr. E. Wood of Richmond, Yorkshire, has been purchased by Mr. William Reed, F.G.S., of York, and by him presented to the Museum of the Yorkshire Philosophical Society, York. The collection consists of about 10,000 specimens, and is specially rich in fossils from the Carboniferous rocks.

THE great *soirée* of the Paris Observatory will take place on February 5. One of the features of the display will be a series of vacuum tubes exhibiting the spectral peculiarities of the several gases inclosed.

DR. FRITSCH, Professor of Zoology at the University of Prague, has sent us a specimen of a cast, taken by the galvanoplastic process, of a skeleton of one of the extraordinary Labyrinthodont reptiles, described by him in his work, "Fauna der Gaskohle der Permformation Böhmens." As the matrix in which these skeletons are found contains much pyrites, it soon crumbles away on exposure to the air. By this process of Dr. Fritsch's the specimens however may be examined, even when magnified twenty-fold, and all little minutiæ of the skeleton can be seen. Complete sets of these galvano plastic casts, representing all the more important reptile remains found, can be had on application to Prof. Fritsch.

IN Siberia, a country so rich in gigantic fossils, the body of a colossal rhinoceros has been discovered in the Werchojanski district. It was found on the bank of a small tributary to the Jana River, and was laid bare by the action of the water. Similar to the mammoth washed ashore by the Lena River in 1799, it is remarkably well preserved, the skin being unbroken and covered with long hair. Unfortunately only the skull of this rare fossil has reached St. Petersburg, and a foot is said to be at Irkutsk, while the remainder was allowed to be washed away by the river soon after it had been discovered. The investigation of the skull gave the interesting result that this rhinoceros (*R. Merckii*) is a connecting form between the species now existing and the so-called *Rhinoceros tichorrhinus*, remains of which are not unfrequently found in the gravel strata of Eastern Prussia. It is supposed that *R. Merckii* is the now extinct inhabitant of the eastern part of Siberia.

HERR JULIUS GILLIS, a wealthy merchant of St. Petersburg, offers a prize of 1000 florins for a popular work on "Kant's Views on the Ideality of Time and Space." Herr Gillis will not only pay the cost of publishing of the work which obtains the prize, but will also let the author have the profits its sale may realise. Details regarding this matter can be obtained from Last's Literary Institute at Vienna.

MR. WARREN DE LA RUE will, on Friday next, the 21st inst., deliver his discourse at the Royal Institution on "The Phenomena of the Electric Discharge with 14,400 Chloride of Silver Cells." Prof. Schafer will give the first of a course of twelve lectures on the Blood, on Tuesday next (January 25), Mr. Francis Hueffer, the first of a course of four lectures on the Troubadours, on Thursday next (January 27), and Mr. Sidney Colvin the first of a course of four lectures on the Amazons, on Saturday next (January 29). The next Friday evening discourse will be given by Dr. Arthur Schuster, on the Teachings of Modern Spectroscopy, on January 28.

MR. E. T. SACHS sends us some interesting notes from Batavia:—"Within the past month I have been so lucky as to make what I hope is a very interesting if not remarkable discovery. On the Island of Biliton, 200 miles from here, I found a freshwater fish which produces its young *living from its mouth*. I am quite prepared for the cry of incredulity that will be raised, but I conducted my observations with living fish and closed doors, and what I assert is undeniable: the eggs are hatched in the lower portion of the head of the fish, and are projected out at the mouth and from nowhere else. I have secured several specimens, which I shall send to Dr. Gunther, who will of course at once set the matter at rest. I also got on Biliton a butterfly, which is either a new Thecla or else it is the male of the pretty *Myrina nivea* peculiar to the island. I fancy it must be the latter. I was only three weeks on the island on other business, and was never two miles from the shore, so I have reason to be satisfied with my trip. I mean to go again next May or thereabouts, and go into the interior, and also try to get some living fish to breed from in Batavia. . . . There is a Dr. Schluyter here who is working hard at invertebrates. He is just busy on the tri-pang family, and will no doubt produce a fine monograph. He gets some fine crustaceans from the Straits of Sunda. I have shown him my fish, and he knows nothing of it."

ON the subject of crickets Mr. Sachs writes:—"These are sold in the markets in Batavia, inclosed in small bamboos. There is not much superstition about it, as little ticklers (pieces of stick with a bunch of plants analogous to our broom tied on the end) are sold with it wherewith to stir up the unfortunate insect when it doesn't chirp. Only children buy them."

A SHARP shock of earthquake was felt at Peshawur at 4 a.m. on December 10. The atmosphere was clear at the time; small drafts and eddies of cold wind followed the shock. The previous evening there had been a few drops of rain, the first for three months. The temperature was rather warmer than it had been, owing to the sky being more overcast. A smart shock was felt at the Bridge of Allan, near Stirling, on the morning of the 12th, about seven o'clock. There was a severe shock at Thurgau on the night of the 13th, accompanied by underground noises.

THE difficulties of the old Paris Municipal Council with the gas company were not adjusted before its dissolution. We believe that the new Municipal Council is sure to accept all the proposals coming from any gas company which has proved practically by some previous experiments the value of their system, and are willing to accept a remuneration proportional to the quantity of light produced on a scale similar to the Lontin agreement, viz. 10 deniers for each 120 or 130 sperm candles.

THE French Government has appointed an engineer of the Ponts et Chaussées, M. de Villier du Terroge, to report on the possibility of establishing in Paris underground railways. The difficulty is in the length of the tunnels to be excavated, which will be greater than on the Metropolitan Railway, and the necessity of procuring smoke-consuming engines.

ON the 7th inst. a silver tea and coffee service was presented by the Mayor of Liverpool, in the name of a large number of subscribers, to Mr. A. Norman Tate for his disinterested efforts to promote scientific education in that city.

A GENERAL Horticultural Exhibition will be held at Frankfort-on-Main from May 1 to October 1 this year. Particulars may be obtained by applying to "Die Gartenbau Gesellschaft" at Frankfort-on-Main.

THE Electric Railway, constructed by Siemens and Halske, between the Anhalter Station, in Berlin, and the suburban village of Lichtenfeld, has been satisfactorily completed, and will be opened to public traffic on the 1st of next month.

A NEW electric lamp has been brought out in Paris; it is a combination of the Werdermann with a perforated carbon filled by an insulating medium. It is said to work well.

AT a meeting of the Council of the Epping Forest Naturalists' Field Club, held on Saturday evening, January 8, the following resolution was passed on the motion of Mr. Francis George Heath, seconded by Mr. N. F. Robarts, F.G.S.—"That the Council of this Society, on behalf of the large section of the population of London interested in the pursuit of Natural History, desires to record an emphatic protest against the proposal of the Great Eastern Railway Company to carry a line across Epping Forest, believing that it is wholly unnecessary for the Railway to take the route projected, and that it would not fail to prejudicially affect the advantages secured by the Epping Forest Act, which directs that the forest is to be preserved as far as possible in its natural aspect."

OUR ASTRONOMICAL COLUMN

JANSON'S STAR OF 1600.—The so called *Nova* of 1600, which is 34 Cygni of Flamsteed, and P Cygni of Schonfeld's catalogues of variable stars, was discovered by Wilhelm Janson, a pupil of Tycho Brahe's, and entered upon his globe in that year. It has been erroneously stated in some astronomical works (as in Cassini's "Elements d'Astronomie) that Kepler was a co-discoverer of this star, of which he himself informs us to the contrary in his treatise, "De stella tertii honoris in Cygno, quæ ad annum MDC fuit incognita necdum extinguatur, Narratio astronomica", this is appended to his well-known work, "De stella nova in pede Serpentarii," published at Prague in 1606. At p. 154 we read, "Cum mense Majo anni 1602 primùm literis monerer de novo Cygni phænomeno," &c., while at p. 164 Kepler says distinctly that Janson was the discoverer, "Primus est Gulielmus Jansonius, qui hanc novam a se primùm anno 1600, conspectam profitetur inscriptum in globum cælestem anno 1600 editum factâ." Kepler gave the position of the star for the end of 1600 in R.A. 300° 46′, Decl. + 36° 52′. He observed it during nineteen years, it became fainter in 1619, and disappeared in 1621, though Fortuni Liceti dates a reappearance in the same year. In 1655 Dominique Cassini observed it again, it increased during five years, until it attained the third magnitude, and afterwards diminished. On the testimony of Hevelius, it reappeared in November, 1665, it was again faint in the following year, but subsequently brightened without reaching the third magnitude, in 1677 and 1682, it was only of the sixth magnitude. Cassini says on June 24, 1715, a star of this magnitude was seen in the position of P (Bayer) equal to the three which are near that marked *b* in Cygnus by Bayer.

Edward Pigott was at some pains to elucidate the history of this star in a communication presented to the Royal Society in 1786 (*Philos. Trans.* vol. lxxvi. p. 189). He says he had minutely examined the observations made in the previous century with the following results as to the star's fluctuations:—

1. Continues at its full brightness for about five years.
2. Decreases rapidly during two years.
3. Invisible to the naked eye for four years.
4. Increases slowly during seven years.
5. All these changes, or its period, are completed in eighteen years.
6. It was at its *minimum* at the end of the year 1663.

It does not always increase to the same degree of brightness, being sometimes of the third, and at other times only of the sixth magnitude. He adds that he was entirely ignorant whether it were subject to the same changes since the beginning of the eighteenth century, as he had not met with any series of observations upon it.

It cannot be said that Pigott's conclusions (which Schonfeld appears to think are only indifferently supported by the observations upon which they are stated to be founded) have received any confirmation since his time. If in the absence of systematic series of observations we consult the catalogues of the present century, we have the following estimates of magnitude amongst others:—Piazzi, 5·6; Bessel, 6·7 (on September 14, 1825); Argelander's *Uranometria*, 5; and *Durchmusterung*, 5·3; Yarnall, 5·2; Radcliffe observations, 1870, 5·8. But in view of the undoubted variation in the brightness of this star in past times, more regular observation seems desirable. Has it ever been carefully examined under the spectroscope? Its light has a strong yellow cast. Madler found no appreciable proper motion. The star occurs in the second Radcliffe catalogue, and in the Greenwich catalogue of 1864. The position carried back to Kepler's epoch from these authorities is in close accordance with that given in his treatise.

THE NEW CAPE CATALOGUE.—At the meeting of the Royal Astronomical Society on the 14th inst. the Radcliffe observer, Mr. E. J. Stone, laid upon the table the complete sheets of his great Catalogue of Southern Stars, observed during his superintendence of the Royal Observatory, Cape of Good Hope, which has been printed since his return to England. This very important work contains the places of between twelve and thirteen thousand stars, including, in addition to the stars observed by Lacaille, a considerable number of stars falling within similar limits of magnitude. "A stereographic projection, showing the distribution of the stars contained in the Cape Catalogue, 1880, between 110° and 180° N.P.D." has been lithographed by Mr. Stone. We believe a number of suspected cases of large proper motion amongst the southern stars disappear under the new determination of their positions at the Cape.

BIOLOGICAL NOTES

ARCHÆOPTERYX MACRURA.—A very able article on this strange-feathered animal by Prof. Carl Vogt was read before the Saint Gall Meeting of the Congress of Swiss Naturalists, and was published in the *Revue Scientifique* for September, 1879. This has been translated in the recently-published number of *Ibis*, with a photograph of Herr Haberlein's specimen. H. von Meyer, in 1861, described this species (under the specific name lithographica) from the impression of a "bird's" feather in the Solenhofen slate. Prof. Owen, on the discovery by Dr. Haberlein of a specimen (imperfect) described it "as he alone knows how to do." The head of this specimen was wanting. Dr. Haberlein's son, about 1875, succeeded in splitting a slab so skilfully as to have on one of its halves the whole animal, and on the other its impression. This specimen Herr Haberlein is anxious to dispose of, and it is the one described by Carl Vogt. The animal preserved in the slab is of the size of a ringdove. The remains described by Prof. Owen belong to the same species, but to an example greater by a fifth. It is entire; the head, neck, trunk, and hind-quarters are placed in profile, the head is bent backwards, so that its top nearly touches the back. The wings, united at the shoulder girdle, are

spread as if for flight. The head is small, pyramidal, nearly flat The orbit is large, with the nostril in front of it By means of a lens two little conical and sharp teeth are perceived at the end, planted in the upper jaw. On the lower surface there is a forked bone to be seen, but Prof Vogt dare not say whether this is the lower jaw or a tongue bone, the bones of the head show clearly that it is a true reptile's head Its shoulder-girdle proves also to be that of a reptile In fact the head, the neck, the thorax, with the ribs, the tail, the shoulder-girdle, and the whole fore-limb, are plainly constructed as in reptiles. The pelvis has probably more agreement with that of reptiles than with that of birds The hind foot is that of a bird, therefore reptilian affinities prevail in the skeleton over all others The feathers are those of a bird The remiges of the wings are fixed to the ulnar edge of the arm and to the hand, they are covered for nearly half their length with a fine filiform down, none of them project beyond the others It is possible that at the base of the neck there was a ruff like that of the condor. The tibia was clothed with feathers for the whole of its length Archæopteryx thus wore breeches, as do our falcons All the other parts of the body were evidently naked It would thus seem to take its rank neither among birds nor reptiles. It forms an intermediate type of the most marked kind, and confirms in a brilliant way the views of Prof Huxley, who has united birds and reptiles—to form of them under the name of Sauropsids, a single great section of Vertebrates

EUROPEAN AND NORTH AMERICAN BIRDS —The occurrence of North American birds in Europe has always been a subject of interest to ornithologists In the April number (1880) of the *Proceedings* of the Royal Dublin Society there is a paper by Percy Evans Freke giving a comparative catalogue of the birds found in Europe and North America, in which the species of North American birds are arranged in columns side by side with the same species found at times in Europe The geographical distribution of these species is also given, and the residents, which are probably breeders, are distinguished. This list seems worked out with a great deal of care A paper on the same subject by Mr J. J Dalgleish appears also in the April number (1880) of the *Bulletin* of the Nuttall Ornithological Club, with a table giving a "List of Occurrences of North American Birds in Europe" Great care has evidently been taken in this memoir also to secure correctness On comparison of the lists it would seem as if Evans had overlooked Gatke's paper on Heligoland Birds

A GNAT WITH TWO KINDS OF WIVES —Dr. Fritz Muller describes in a late number of *Kosmos* (October) a very remarkable two-winged insect which he calls *Paltostoma torrentium*, and which he found at Itajahi The larvæ were found by him under stones and rocks in the little streams with which this province abounds These larvæ were carefully watched and reared, and the perfect insects on their appearance were found to be males and females, but the latter of two well-marked and very different types In the male gnat the eyes occupy nearly the whole side of the head, and leave not even room for the three ocelli, which are thus forced to the top of a peculiar stalk-like body In one of the two forms of the female the eyes occupy the whole length of the head, but leave between them a broad belt, which in the second form of female is not half so wide or long. In the large eyed females the parts of the mouth are formed after the type of those to be met with in the blood-sucking females of the mosquito or horse-fly But in the small eyed females and in the males this formidable development of the parts of the mouth, which enables the large eyed females to feed on blood, is wanting, and the former are honey-suckers, obtaining this food from the nectaries of several flowers Along with this remarkable difference in the parts of the mouth there is a notable difference in the foot-joints, the honey-sucking wives having slender feet, with smaller claws than their honey-sucking husbands, while the blood-sucking wives have the last foot joint short and wide, furnished on its under surface with a thick pad, from which arise strong curved hairs; the claws are also much longer. Thus the small-eyed honey-loving form has the more simple structure of foot, whereas the blood-seeker has not only the more complicated form of foot, but great eager eyes looking about for what they can get to devour

THE FUNCTION OF ASPARAGINE.—Boussingault's researches seemed to show that asparagine was a substance comparable to urea, the result, like it, of a transformation of albuminous matters, and that this substance made its appearance only in seeds during their germination, but from the discovery of this substance not only in bitter almonds when the embryo is not yet visible; in the same seeds when completely ripe, in the young seeds of the apricot, plum, and cherry, and even in the unopened inflorescences of the pear, M. L Portes sees reason to doubt the propriety of ascribing to it this function. If, he says, Boussingault's experiments show the existence in leguminous plants of an asparagine concomitant with the act of germination—which might be called blastemic asparagine—there also exists in the almond tribe and pear buds, another form apparently not having any physiological connection with the other, which may be referred to as ablastemic In both cases the asparagine is a secondary product, its formation is in intimate connection with the production of new cells Sweet and bitter almonds gathered in March in the middle of France were proved to contain neither sugar nor starch, but dextrine was present. Previous analysis allows one to affirm that neither sugar nor starch ever existed in them, nor as yet were they in the flowering stalk. May it not be admitted that the dextrine and glucose which speedily appear have at least in part an albuminoid origin? since the seed does not contain, nor will it for a long time contain, starch, since the young seed shows no sugar, and lastly, since there is a product of excretion representing the azote of the transformed protoplasmic matter (*Revue Internationale des Sciences biologiques*, October 15)

A CAUSE OF THE MOTION OF DIATOMS.—According to one view diatoms move by means of strong osmotic processes, which, being more intense in one direction, cause impulsion in the other. Some observations by Herr Mereschkowsky supporting the latter view are described by him in the *Botanische Zeitung* (1880, p 529) He examined two species of Navicula and one of Stauridium in sea-water containing many very small micrococci, which, near the diatoms, vibrated greatly, but at a distance were quite still It was first evident that the movements of the diatoms consisted of a straightforward motion, then a backward, with a pause between, or of a turning round the axis. Then it was noticed that so long as the diatom remained still, all the actively vibrating micrococci were uniformly distributed, whereas, when the diatom moved, the micrococci vibrated with excessive activity at the hinder end, as if a strong water current entered behind the alga At the fore end there was only a very slight motion of micrococci When the still state was reached the vibration became again equally distributed, and on commencement of the backward motion a reverse distribution of the vibration was observed. These phenomena (observed also in rotation of diatoms) can only be explained, the author considers, by the hypothesis above stated.

FUNGAL GROWTHS IN THE ANIMAL BODY —By experiments on animals, Herr Grawitz (*Virchow's Archiv*, B. 81, p 355), has recently proved the following:—1 The well-known mould fungi *Eurotium* (*Aspergillus*) and *Penicillium* occur in two varieties, which are quite alike in form, but quite different physiologically, the one proving wholly indifferent in the blood-system of the higher animals, while the other has all the malignity of the worst pathogenic fungi known 2 From any original form both varieties can be obtained by continued cultivation, and similarly from either of the two varieties the other may be got, in twelve to twenty generations, by systematic cultivation 3. The principle of the cultivation is to habituate the fungi which live on solid, weakly acid, nutritive substances at a temperature of about 8° to 20° C, through a series of generations, to liquid alkaline albumen solutions, and a heat of 38° to 40° C. 4 The malignity of the pathogenic mould-fungi consists, in acute cases, in their spores, which on reaching the circulation of the higher mammals, there germinate, and passing into different parts of the body, multiply, and cause local neuroses, and death in about three days. In the subacute and chronic cases a reactive inflammation occurs in each of the numerous fungus centres, which may cause the death of the hyphæ and lead to cure. 5 Most of the small mould-accumulations easily seen with the naked eye in the kidneys, liver, muscles, and retina, are microscopically distinguishable neither by size nor by histological characters from fungi of the same species, which have grown on their favourite substrata, except that they have only rudimentary fruit-stalks, and never attain to the separation of spores

BRAIN-WEIGHT.—The weight of the human brain, according to a recently published work by the eminent Munich anatomist Prof, Bischoff, is on an average 1362 grammes for man and 1219 gr. for woman The difference between the average brain-weight of man and woman thus amounts to 143 gr, or 10 50 per cent.

The brain-weight of man exceeds that of all animals except the elephant (4500 gr.) and the larger Cetaceæ (2500 gr.) The brain weight of the largest apes is hardly a third of man's Prof. Bischoff has worked with a considerable amount of material; his data comprise the weights of brain of 559 men and 347 women.

PHYSICAL NOTES

EXPERIMENTS have been made by Herr Glan (*Wied. Ann.* No. 11) as to the action of gases and vapours on the optical properties of reflecting surfaces. No such influence (expressed in alteration of phases in reflection) is found to exist if the gases and vapours do not act chemically on the surfaces, or are not precipitated in visible quantity (as when the temperature is below the dew point).

DR. FUCHS describes a new interference photometer (*Wied Ann.* No. 11) in which no polarisation of the rays at right angles to each other is required. It consists simply of two similar isosceles glass prisms joined by their basal surfaces, which enclose an air layer variable in thickness by pressure A diaphragm reaches out in prolongation of the surface of junction. The observer looks obliquely towards this surface and sees one illuminated surface directly through the double prism, the other by reflection at the air layer One light-source is fixed, and the other is displaced till the interference bands disappear.

THE polar differences in luminous phenomena of the discharge of electricity through gases were considered by Wiedemann and Rühlmann as possibly due, in part at least, to a gas layer (more or less condensed) on one electrode Supposing that other kinds of envelopes with like action would essentially affect the phenomena, Herr Holtz has been able (*Wied. Ann.* No. 11), by covering one electrode, *e.g.* with silk, or placing a stretched silk disk before it, to verify this, and almost quite obliterate, in some cases, the polar differences.

IN a recent publication describing electrical researches, by Herr Goldstein, in Berlin, that author investigates the phenomena which occur when, in a space so far evacuated that the green phosphorescent light occurs with the discharge from the cathode, there are, not one, but several cathodes. He has met with a new form of electrical repulsion, not to be classified either with the mechanical repulsion in collision of ponderable masses, or with electrostatic or electrodynamic repulsion. (An abstract of the memoir appears in *Wiedemann's Beiblätter*, No. 11)

APPLYING his theory of the potential energy of liquid surfaces to great cycle operations in nature, M. van der Mensbrugghe (*Bulletin* of Belg. Acad., 9 and 10) has lately calculated that if evaporation subdivides the liquid of seas into spherules of *e.g.* 1-10,000th mm. diameter, each kilogramme of water presents a collection of spherules whose total potential energy is equivalent to 450 kilogrammetres, *i e.* more than a million times that of a sphere of compact water also weighing 1 kilogramme This shows what prodigious quantities of work-units are carried virtually into the atmosphere by water vapour, and there is to be added the potential energy acquired by this vapour in virtue of its weight. The author applies his theory to the effects of condensation, to glazed frost, to phenomena of rivers and waterfalls, &c. He anticipates important verifications of it from the examination of the Gulf Stream in the Gulf of Mexico projected by the United States, and recent soundings have tended to confirm it.

M. MONTIGNY (*Bull* Belg Acad 9 and 10) has lately studied the effects of making bells vibrate with liquids in them (water, ether, alcohol, sulphide of carbon), or when wholly immersed in liquids He found that (1) the sound produced was always more grave than the natural sound, (2) that the lowering of tone was more marked in both cases the more dense the liquid (thus it is less with ether than with sulphide of carbon); (3) that with all the liquids tried the alteration in sound of a given bell was much more marked when the bell was wholly immersed than when merely filled with the liquid; and (4) that in both cases the lowering of tone was more marked for grave than for acute notes. The general inference is that the rapidity of vibrations of a sounding body is considerably diminished by a liquid with which its walls are in contact, and that this diminution is more sensible when the contact is established on both sides of the vibrating body than when only on one side. The mode of action is related not only to the density, but to the compressibility of the liquid. The lowering of sound is more sensible with water than with alcohol and ether; the latter being less dense and more compressible liquids. The form of the bell and the nature of its substance (that is its special elasticity and its density) are shown also to affect considerably the pitch of the sound produced in contact with liquids M. Montigny is investigating whether air is a medium of too little density and too great compressibility to modify sensibly the duration of vibrations of sonorous bodies.

AT a recent meeting of the Franklin Institute (*Journal* for December), Mr. Griscom described his new electric motor, which, weighing about 2½ pounds, compares favourably with those of the old forms of fifteen times its weight Its most essential advantage is in the field magnets; the shape of which is such that all the magnetic lines of force, including those nearest the neutral line, are brought into the best possible position for effecting the revolution of the armature. If a bar of soft iron is pivoted at one end to move in a horizontal plane, and a semicircular magnet is placed concentrically with the circle the bar can describe, then a given force is exerted on the bar at a much greater distance from the poles when the latter is within the semicircle than when it is without. Herein (it is stated) is the secret of the power of Mr. Griscom's motor The battery is inclosed in a strong waterproof box, gives no odour, and very little trouble in renewing. It is calculated that it will suffice for the sewing of a small family for one year, a professional seamstress would exhaust it more rapidly, but always in proportion to the exact amount of work done.

A NEW microphone, made by M Boudet in Paris (*La Nature*, No. 394), has the general shape of a telephone on a support. It comprises a mouthpiece, in which is an ebonite plate 1 mm. thick, with a short bar of copper penetrating from its middle a short way into a glass tube in which are six little balls of retort carbon in a row, a second mass of copper following the last, and resting on a small spiral spring in a case. The pressure can be varied by means of a screw. The instrument is worked with six Gaiffe elements (peroxide of manganese and chloride of zinc) mounted in tension, and a Bell telephone. It is said to transmit the voice very distinctly without altering its timbre and without disturbing sounds being produced

IN a note to the Vienna Academy (*Anz.* December 16) Prof. Stefan describes experiments on the influence of terrestrial induction in development of an electric current, and the excitement of the telephone by currents from a rotating coil. The coil used was 56 mm. in external diameter, and 11 mm. in width. The earth's influence is best shown by so connecting the apparatus with a galvanometer that the circuit is closed during one half of the coil's rotation, and broken during the other half; if the completion of the circuit correspond to the positive maximum of the electromotive force of the earth's magnetism, and the interruption to the negative, the galvanometer is positively deflected. The deflection may be reduced to zero by displacing the contact, and from the displacement and the number of rotations the potential may be inferred in absolute measure. Next the telephone was so connected with the coil that the full alternately opposite currents went uninterruptedly through the circuit. This gave a simple tone With 100 rotations per second the horizontal component of the earth's magnetism did not suffice to excite an ordinary telephone, but it excited one having a horse-shoe magnet. (When the intensity of the field was doubled the ordinary telephone was also excited.) The tone corresponds to the number of rotations When the coil was rotated 220 times in a second the ordinary telephone sounded The telephone was shown to be less sensitive to currents whose intensity periodically changes than to interrupted currents (an ordinary telephone sounded with 100 rotations or fewer, when the circuit was closed only during a short time of each rotation)

GEOGRAPHICAL NOTES

AT the meeting of the Geographical Society on Monday evening a paper was read on the discoveries made by Mr. Leigh Smith last year on the coast of Franz Josef Land, including also a general sketch of the rest of his voyage in the *Eira.* Mr. Smith appears to have reached the southern shores of Franz Josef Land with comparative ease about the middle of August, and to have examined it and several islands along a coast-line of over 100 miles of previously unexplored ground. The new continent, as some would fain believe it to be, does not present an attractive appearance, for the coast-line is described as consisting

of glaciers with dark frowning and flat-topped cliffs, here and there reaching to a height of 1200 feet. It was after passing Barents' Hook that new ground was actually broken, and the exploration was continued westwards until Mr. Smith succeeded in rounding the western headland. The farthest point actually reached by the *Eira* was in N. lat. 82° 20', E. long. 45°, and thence the land could be seen trending away to the north-west. During the voyage a meteorological record was kept, photographs taken, and various collections made, chiefly of botanical and geological specimens.

THE January number of *Petermann's Mittheilungen* contains an account of a journey from Dufilé to Lur, on the west shore of Lake Mwutan-Nzige, by Dr. Emin Bey, in the last months of 1879. Herr Clemens Denhardt brings together much valuable information on the East African region between Mombasa and the Victoria Nyanza, with special reference to the trade-routes, accompanied by an excellent map. An article of special scientific interest is contributed by Dr. H. Hoffmann on the Comparative Phænology of Central Europe. In a series of tables and in a map the average time of bloom is shown for a very large number of places, with reference to Giessen as a standard. There is a very interesting account by Baron Nordenskjold of his visit to Behring Island, followed by some critical remarks on the vegetative region of the Serra da Estrella, by Dr. O. Drude.

Bulletin, No. 5, 1879, of the American Geographical Society contains a paper by General R. E. Colston on "Life in the Egyptian Deserts," and an amusing lecture by Lord Dunraven on "Moose and Cariboo Hunting."

THE French station of the African Association has been established by M. Savorgnan de Brazza at Nghimi, on the route from Machogo to Levumba, in the region of the sources of the Ogové, in 1° 30' S., and about 11° E. from Paris.

THE publication in which the results of the determination of the South American longitudes by electricity have been tabulated by American observers has just arrived in Paris. All the positions determined by M. Mouchez on the Brazilian coast have proved correct within a difference of 1½ second of time. These determinations were taken by Admiral Mouchez when a subordinate officer in the French service twenty years ago, by lunar distances, occultations, and eclipses.

THE author of the summary of Geographical Discovery in *Whitaker's Almanac* writes to us in reference to the notice on p. 232, that it is not stated that Mr. Leigh Smith's voyage is "the most remarkable geographical event of the year," to the depreciation of Mr. Thomson's African journey, "but that, in spite of the success of the latter, Mr. Smith's voyage would probably be considered by many as the most remarkable geographical event of 1880." We doubt if "many" would hold such an opinion, merely for the reason assigned in the *Almanac*. "May I be allowed to point out," he adds, "that the word 'research' means careful search or investigation? and that mere searching for the North Pole is not the sole object of Arctic voyages?" We are glad the writer is of this opinion, though we doubt if Mr. Leigh Smith's voyage has much bearing on Polar "research."

CHESAPEAKE ZOOLOGICAL LABORATORY

A REPORT of the third year's work at the Chesapeake Zoological Laboratory of the Johns Hopkins University has been addressed to the President of the University by Mr. W. K. Brooks, Director of the Laboratory. An advance copy of this has been sent us, from which we make some valuable extracts.

The laboratory was opened at Beaufort, North Carolina, on April 23, 1880, and closed on September 30, after a session of twenty-three weeks. It was supplied with working accommodations for six investigators, and the facilities which it afforded were used by the following six persons:—W. K. Brooks, Ph.D., Director; K. Mitsukuri, Ph.B., Fellow in Biology; E. B. Wilson, Ph.B., Fellow in Biology; F. W. King, A.M., Professor of Natural Science, Wisconsin State Normal School; H. C. Evarts, M.D., Academy of Natural Sciences, Philadelphia; H. F. Osborne, Ph.D., Fellow of the College of New Jersey.

Beaufort was selected for the third season's work because it is the nearest accessible town south of Baltimore which is favourably situated for zoological study. The scientific advantages of Beaufort are very great; the most important is the great difference between its fauna and that of the northern Atlantic coast.

"The configuration of our coastline," the Report goes on, "is such that Cape Hatteras, the most projecting point south of New York, deflects the warm water of the Gulf Stream away from the coast, and thus forms an abrupt barrier between a cold northern coast and a warm southern one. The fauna north of this barrier passes gradually into that of southern New England, while the fauna south of the barrier passes without any abrupt change into that of Florida, but the northern fauna is sharply separated by Cape Hatteras from the southern. As the laboratory of the U.S. Fish Commission and Mr. Agassiz's laboratory at Newport afford opportunities for work upon the northern fauna, it seemed best for us to select a point south of Cape Hatteras in order to study the southern fauna with the same advantages, and as Beaufort is the only town near the Cape which can be reached without difficulty, it was chosen as the best place for the laboratory. The situation of this town is exceptionally favourable for zoological work, for the surrounding waters present such a diversity of conditions that the fauna is unusually rich and varied."

After describing in detail the special characteristics of the locality Mr. Brooks goes on to say:—

"The zoological resources of Beaufort have not escaped the attention of American naturalists, and there are few places upon our coast, outside of New England, where more zoological work has been done. In 1860 Drs. Stimpson and Gill spent a season in dredging and collecting in the vicinity of Beaufort, Cape Lookout, and Cape Hatteras, and an account of their work was published in the *American Journal of Science*. Dr. Coues, who was stationed at Fort Macon during the war, occupied himself for two years in collecting the animals which are found here, and he published a series of papers on the 'Natural History of Fort Macon and Vicinity' in the *Proceedings* of the Academy of Natural Sciences of Philadelphia. These papers, which were continued by Dr. Yarrow, contain copious and valuable notes on the habits and distribution of the animals which were observed, and we found them a great help to us. These two naturalists found 480 species of animals in the vicinity of Beaufort. Of these 480, 298 are vertebrates, and 182 are invertebrates. Of the vertebrates 24 are mammals, 133 are birds, 27 are reptiles, 6 batrachians, 97 fishes, and 11 selachians. Of the invertebrates 147 are mollusks, 21 are crustaceans. The list of vertebrates is very nearly exhaustive, and we made no additions to it, but the list of invertebrates is obviously very imperfect, and although we made no attempt to tabulate the species which we observed, there would be no difficulty in enlarging the list twenty or thirty fold.

"Among other naturalists who have spent more or less time at Beaufort I may mention Prof. L. Agassiz, Prof. E. S. Morse, Dr. A. S. Packard, Prof. Webster, and Prof. D. S. Jordan. Prof. Morse procured most of the material for his well-known paper on the Systematic Position of the Brachiopoda on the Sand-bars in Beaufort Inlet.

"I will now attempt to give a very short statement of some of the leading points in our own summer's work. Much of our time was spent in studying the development of the Crustacea, since this is one of the most important fields for original work upon our southern coast. The supply of material is almost inexhaustible, and would employ a number of students for many years. The life-history of the Crustacea is of great interest in itself, and the recent species are so numerous and diversified that there is no group of animals better adapted for studying the general laws of embryonic development in their relation to the evolution of the group. These considerations have led us to devote especial attention to this group during this and the preceding seasons. One of the published results of the first season's work was an illustrated account of the metamorphosis of Squilla, a representative of a somewhat aberrant group of Crustacea. During the second season a member of our party, Prof. Birge, made a very thorough study of the development of Panopæus, one of our crabs, and the account of his observations, with drawings, was ready for publication several months ago. At Beaufort we spent most of our time upon this subject, and figured more than 800 points in the development of various Crustacea.

"Among these I wish to call especial attention to our observations upon the development of the Sergestidæ, the least specialised of the stalk-eyed Crustacea. This very peculiar group was not known to occur upon our coast until we found a few

specimens of one genus at Fort Wool, and the same genus—Lucifer—in great abundance at Beaufort, associated with another genus which is also new to North America. As nothing whatever was known of the development of Lucifer, we made every effort to obtain the eggs and young, and after four months of almost fruitless labour we finally succeeded in finding all the stages of the metamorphosis, and figured them in a complete series of ninety-nine drawings. We also obtained a somewhat less complete series of figures of stages in the life history of the second Sergestid. Our only motive in this work was the desire to fill a gap in our knowledge of crustacean development by supplying the life history of a very interesting group of animals, but the result was found to have a very unexpected value, since it contributes to the discussion of a number of problems in general embryology and morphology, and is the most significant crustacean life history which has ever been studied.

"The following are some of the more important points.—The egg undergoes total regular segmentation. There is no food-yolk, and cleavage goes quite through the egg. There is a true segmentation cavity. Segmentation is rhythmical. There is an invaginate gastrula. The larva leaves the egg as a Nauplius, and passes through a protozoea stage and a schizopod stage. The fifth thoracic segments and appendages are entirely wanting at all stages of development.

"Another interesting group which was studied is the Porcellanidæ; the least specialised of the true crabs. The adults of our American species are almost restricted to our southern waters, although the swimming larvæ are carried north by the Gulf Stream. Within the last two years two northern naturalists have studied these floating embryos upon the south coast of New England, but as they were working upon stragglers so far from home, their accounts are incomplete and somewhat contradictory. Our advantages at Beaufort enabled us to contribute towards the solution of this confused subject by raising one species of Porcellana from the egg. We also raised six other species of crabs from the egg, and made drawings of the more important stages of development. One of the species which was thus studied is the edible crab. Its metamorphosis has never been figured, and although it presents no unusual features, its economic importance gives value to exact knowledge of its life history. Mr. Wilson also studied the development of one species of Pycnogonida, a group of very peculiar Arthropods distantly related to the spiders. As he has paid especial attention to the systematic study of this group, and is now engaged in describing the Pycnogonids collected in the Gulf Stream by Mr. Agassiz, the opportunity to study them alive in the laboratory has been a great advantage to him.

"Another important investigation is the study by Mr. Wilson of the embryology of the marine Annelids. Although the representatives of this large group are abundant and widely distributed, little was known of the early stages of their development until he procured the eggs of several species and studied them at Beaufort. This investigation has shown, among other things, that the accepted division of Annelids into two great groups, the Oligochæta and Polychæta, is not a natural method of classification. The work upon the development of marine Annelids was supplementary to an investigation which Mr. Wilson carried on last spring at Baltimore, and which he will continue this winter, upon the development of land- and freshwater Annelids.

"As much time as possible was given this season to the study of the hydroids and jelly-fish of Beaufort. The life history of several of them were investigated, a thorough anatomical study of some of the most important forms was carried on, and nearly two hundred drawings was made. It is almost impossible to complete a study of this kind in a single season, but if one or two more summers can be given to the work, we have every reason to hope for valuable results, for although the North Carolina coast is the home of many species which are only found as stragglers upon our northern coast, and of other species which are not known to occur anywhere else, and of some genera and families which are new to the North American coast, this field has suffered almost total neglect.

"Nearly three months of the time of two members of our party, Mitsukuri and Wilson, were given to the study of the habits, anatomy, and development of Renilla, a compound Polyp very much like that which forms the precious coral, but soft and without a stony skeleton. The animals which form the community are so intimately bound together that the community as a whole has a well-marked individuality distinct from that of the separate animals which compose it. The compound individuality of Renilla is quite rudimentary as compared with that of a Siphonophore, and as there is no trace of it in the closely allied Gorgonias, it furnishes an excellent field for studying the incipient stages in the formation of a compound organism by the union and specialisation of a community of independent simple organisms. With this end in view the anatomy of the fully-developed community was carefully studied, and the formation of a community was traced by rearing a simple solitary embryo in an aquarium until a perfect community had been developed from it by budding. During the process of development the law of growth by which the characteristics of the compound organism are brought about was very clearly exhibited, and it is fully illustrated by nearly one hundred drawings.

"One of the most interesting results of our work is the explanation by Mr. Wilson of the origin of the metamorphosis of the larva of Phoronis, a small Gephyrean worm which lives in a tube. Several of the most noted embryologists of Europe have studied the development of Phoronis, and our knowledge of its life history is due to their combined labours. Last summer Mr. Wilson reviewed the subject, and added some important points, and during the present season he has shown by the comparison of a great number of allied forms that the very peculiar metamorphosis admits of an extremely simple explanation. The adult is sedentary and confined to its sand tube, while the larva is a swimming animal totally different in structure. The change from the larva to the adult is very rapid and violent. It occupies only a few minutes, and during the change the larva becomes turned wrong side out, so that what was internal is external. Mr. Wilson's comparison shows that Phoronis was originally a free animal, and that the structural peculiarities which fit the adult for sedentary life in a tube are of recent acquisition. The larva has however retained its ancestral adaptation to a swimming life in order to provide for the distribution of the species. There must have been a time, in the evolution of the species, when the adult was imperfectly adapted to a sedentary life, and also imperfectly adapted to a swimming life; and if the development of the individual were a perfect recapitulation of all the stages in the evolution of the species, we should have, between the swimming larva and the sedentary adult, a stage of development during which the adaptation is not quite perfect for either mode of life. It is clearly an advantage for the animal to pass through this stage as quickly as possible, or to escape it altogether. The peculiar metamorphosis enable the larva to remain perfectly adapted to a locomotor life until the occurrence of the sudden change which fits it for life in a tube, and Mr. Wilson has pointed out the manner in which the metamorphosis has been acquired in order to bridge over the period of imperfect specialisation. This explanation is somewhat similar to that which Lubbock has given of the origin of the metamorphosis of insects, and we may hope that the same method of investigation will throw light upon the significance of other remarkable instances of metamorphosis in the invertebrates.

"During the summer the following abstracts of some of the more important points in our work have been published in scientific journals:—

The Development of the Cephalopoda and the Homology of the Cephalopod Foot. By W. K. Brooks. *Amer. Journal of Science.*

The Development of Annelids. By E. B. Wilson. *Amer. Journal of Science.*

The Rhythmical Nature of Segmentation. By W. K. Brooks. *Amer. Journal of Science.*

The Origin of the Metamorphosis of Actinotrocha. By E. B. Wilson. *Amer. Assoc., Boston Meeting.*

Notes on the Medusæ of Beaufort. By W. K. Brooks. *Amer. Assoc., Boston Meeting.*

Budding in Free Medusæ. By W. K. Brooks. *Amer. Nat.*

Development of Marine Polychætous Annelids. By E. B. Wilson. *Zoologischer Anzeiger.*

Embryology and Metamorphosis of Lucifer. By W. K. Brooks. *Zoologischer Anzeiger.*

The Early Stages of Renilla. By E. B. Wilson. *Amer. Journal of Science.*

"Other abstracts are now in the press, and others are ready for publication.

"A paper, with four plates, on the 'Early Stages of the Squid,' is also in the press, and will soon be issued in the Memorial Volume of Memoirs of the Boston Society of Natural History."

ELASTICITY OF WIRES[1]

THE experiments described in this paper form a continuation of experiments undertaken in connection with the work of the Committee of the British Association for commencing secular experiments on the elasticity of wires.

Long-continued application of stretching force increases to a very great extent the tensile strength of soft iron wire. Thus in experiments described to the British Association in 1879 (see Report of the Committee just referred to), a particular very soft iron wire was shown to have a breaking weight 10 p.c. higher if the weight necessary to break it is applied half a pound at a time per day, than it has if the breaking weight is applied half a pound at a time at intervals of say two minutes. It was found also that this wire, quickly broken, extends before breaking by as much as 25 p.c. of its original length, whereas if the application of the stress is very slow, the extension is not more than 5 or 6, or perhaps 8 p.c. Further experiments have been undertaken on this subject, and are still in progress.

Using a continuous arrangement for applying the stretching weight and employing some very soft iron wire which had been specially prepared, and which was used in former experiments, the greatest weight which could be rapidly put on the wire without breaking it was determined. It was found that with a weight of 41 lbs. gradually applied in 6¼ minutes the wire stretched by 24.4 p.c. of its original length, and broke 18 minutes after the weight was put on. With the same weight, 41 lbs., applied in 6¾ minutes, the wire stretched 22.1 p.c. and broke in 24 minutes. With 41 lbs., however, applied in 7¼ minutes, the wire stretched 18 p.c., and did not break. This weight, therefore, appeared to be just as much as the wire would bear with this method of applying the weight. Accordingly it was applied to a great number of wires for different lengths of time for the purpose of hardening them, and arrangements have been made for keeping a number of wires for very long times with this stretching force applied to them. The amount of extension produced by the application of the hardening stress was observed in each case.

After the hardening stress had been applied for a certain time the additional weight necessary to break the wire was determined, and also the additional elongation before breaking, which was in all cases almost insensible. The wires seemed permanently set in about forty minutes from the time when the hardening stress was applied. They did not alter in length till just before they broke, when they generally stretched 1 or 2 millimetres on a length of about 1,800 mm. The following table shows some of the results out of a great many that have already been obtained.

Length of wire used	Hardening stress applied in pounds	Time taken by continuous machine in applying the hardening stress in minutes	Extension produced by application of hardening stress in p.c. of original length	Duration of hardening stress in hours	Total breaking weight after hardening
150 cm	41	6¼	24.4	Broke with 41 lbs	
,,	,,	6¾	22.1		
,,	,,	9½	18.7	24	47.44
,,	,,	7	17.2	27	47.5
,,	,,	8	17.3	117	48.13
,,	,,	7¼	18.1	790	52.31

Curves have also been obtained and were exhibited to the Section showing the extension with gradually applied weights both of a number of wires and of the different parts of the same wire; also curves showing the extension at different intervals of time from the beginning of an experiment in which the wire is running down under a weight sufficient to break it finally.

The author acknowledged the great assistance that he had received from Mr. A. C. Crawford and other students in the Physical Laboratory of the University of Glasgow.

Similar experiments are in progress on wires of copper and tin, and it is intended to test gold wire very soon, as it will probably give interesting results, and results very different from those given by soft iron wires.

[1] Strength and Elasticity of Soft Iron Wires. Abstract of a Paper read at the British Association, by J. T. Bottomley, M.A., F.R.S.E.

SPECTROSCOPIC NOTES, 1879-80

DOUBLE Reversal of Lines in Chromosphere Spectrum.—The magnesium lines of the *b* group, and the two D-lines of sodium have been seen several times (first on June 5, 1880) *doubly-reversed* in the spectrum at the base of a prominence.

A bright line first appears in the centre of the widened dark lines, then this bright line grows wider and hazy at the edge, and a thin dark line appears in its centre, as shown in the figure. The phenomenon lasts usually from ten minutes to an hour. It is evidently the exact correlative of the double reversal of the bright sodium lines, observable in the flame of a Bunsen burner or alcohol lamp under certain circumstances when the quantity and temperature of the sodium vapour in the flame are greatly increased.

The H lines in the Chromosphere and Sun-spot Spectra.—In 1872 I found the H- and K-lines to be reversed in the spectra of prominences and sun-spots, as observed at Sherman, 8000 feet above the sea. Until recently I have not been able to verify the observation, except for a moment during the eclipse of 1878. During the past summer, however, I have succeeded in seeing them again, and with suitable precautions as to shade-glass, adjustment of slit to true focal plane for these special rays, and exclusion of extraneous light, I have no further difficulty with the observation. The spectroscope employed has collimator and view-telescope each of 1¼ inches aperture, and about 13 inches focal length, and a speculum-metal Rutherfurd grating with 17,300 lines to the inch. A shade of cobalt-blue glass greatly aids the observation. The solar image is 1¼ inches in diameter.

In the spectrum of the chromosphere, H and K are both *always* reversed. I have never failed to see them both when circumstances were such that *h*, the nearest of the hydrogen lines, could be seen.

Furthermore, H, in the chromosphere spectrum, is *always double*, that is, a fine bright line always accompanies the principal line, about one division of Ångstrom's scale below. The principal line seems to be exactly central in the wide dark shade, the other is well within the nebulosity. K on the other hand shows no signs of duplicity.

In the spectrum of a sun-spot H and K are also, both of them, generally, though not always, reversed; and the reversal is not confined to the spot, but covers often an area many times larger in its neighbourhood.

In the spot spectrum, however, H has never yet been seen double. The companion line of H is therefore probably due to some other substance than that which produces H and K, a substance prominent in the chromosphere, but not specially so in the neighbourhood of spots. In view of the recent observations of Vogel, Draper, and Huggins, it is natural to think that hydrogen is probably the element concerned. If so, it may be expected that H will be found doubled in the spectrum of a spot which reverses the hydrogen line *h*. I have not yet been able to test it in this way, as *h* is rarely seen reversed, though C and F occur pretty frequently.

[*Note.*—An observation made since my paper was written leads me to modify this opinion, that the companion of H is due to hydrogen, and satisfies me that in all probability both H and K must themselves be hydrogen-lines. At 11 A.M. on October 7, a bright horn appeared on the S.E. limb of the sun. When first seen it was about 3′ or 4′ in elevation, but it rapidly stretched up, and before noon reached a measured altitude of over 13′ (350,000 miles +) above the sun's limb. It faded away and disappeared about 12.30. It was brightest about 11.30 with an altitude of about 8′ and at this time both H and K were distinctly, and for them, brilliantly reversed in it clear to the summit. H was not double in it to any notable elevation though the companion of H was visible at the base of the prominence. The H- and K-lines also showed evidence of violent cyclonic action, just as C did. *h* was only faintly visible in the prominence, F and the line near G were of course strong. But no other lines, either of sodium, magnesium, or anything else, could be traced more than a very few seconds of arc above the sun's limb. I am not able to say how long the H-lines continued visible, or to what elevation they extended afterwards, as I returned to the C-line to watch the termination of the eruption. If I remember rightly, this eruption reached a higher elevation than any before observed. There was (and is to-day) nothing on the sun's limb visible with the telescope which would account for it.—Princeton, October 8.]

Examination of Lines in the Solar Spectrum which are given in the Maps as common to Two or more Substances.—For this purpose a spectroscope of high dispersion has been constructed by combining the grating mentioned above, which has about 4 square inches of ruled surface, with a collimator and observing telescope each of 3 inches aperture and about 42 inches focal length, using magnifying powers ranging from 50 to 200. The apparatus is arranged upon a wooden frame-work, and when in use is strapped to the tube of the 12-feet equatorial of our observatory, so that it is kept by the driving-clock directed to the sun. An image of the sun is formed on the slit by an achromatic object-glass of 3 inches aperture, in order to increase the light and to avoid the widening of the lines due to the sun's rotation. A large prism of about 20° angle was sometimes placed in front of this object-glass (between it and the sun) to separate the colours before reaching the slit, and in examining the darker portions of the spectrum a concave cylindrical lens was sometimes used next the eye, like a shade glass, to reduce the apparent width of the spectrum and thus increase its brightness.

The grating is an admirable one, on the whole the best I have ever seen. But I have been greatly surprised at its excessive sensitiveness to distortion by pressure or inequalities of temperature. Although the plate is fully ⅜ of an inch thick, and only 3½ inches square, an abnormal pressure of less than a single ounce at one corner will materially modify its behaviour, and a quarter of a pound destroys the definition entirely. In fact the plate is not naturally exactly flat, and to get its best performance it is necessary to crowd a little wedge gently under one corner. When it is in good humour and condition, however, the performance is admirable, one could wish for nothing better, unless for a little more light in the violet portions of the spectrum.

With this instrument I have examined the 70 lines given on Angstrom's map as common to two or more substances. Of the 70 lines, 56 are distinctly double or triple; 7 appear to be single, and as to the remaining 7, I am uncertain, in most cases, because I was unable to identify the lines satisfactorily on account of their falling upon spaces thickly covered with groups of fine lines, none of which are specially prominent.

As a general rule the double lines are pretty close, the distance being less than that of the components of the 1474 line. Generally also the components are unequal in width or darkness, or both, though in perhaps a quarter of the cases they are alike in appearance. The doubtful lines are the following, designated by their wave length on Ångstrom's map: 5489.2, 5425.0, 5396.1, 5265.8, 4271.5, 4253.9 and 4226.8. I strongly suspect 5396.1 and 5265.8 (which present no difficulty in identification) of being double, but could never fairly split either of them, and therefore leave them among the doubtfuls.

Those which show no signs of doubling, so far as could be seen, were 6121.2, 6064.5, 5019.4, 4585·3, 4578·3, 4249·8, and 4237.5.

In respect to the lines 5019·4, 4585·3 and 4237.5 it is quite possible there may be some mistake as to the coincidence, since in his *tables* Thalén gives neither of them as due to iron. An accidental strengthening of the dotted line, which, on the map, leads up from the symbol of the element concerned, through the iron spectrum, would account for the matter, by making the line appear on the map as belonging to iron also.

As the facts stand, therefore, it is obvious that arguments which have been based upon the coincidence of lines in the spectra of different elements lose much of their force; it appears likely that the coincidences are in all cases only near approximations. At the same time this is certainly not yet demonstrated. The complete investigation of the matter requires that the bright line spectra of the metals in question should be confronted with each other and with the solar spectrum under enormous dispersive power, in order that we may be able to determine which of the components of each double line belongs to one, and which to the other element. If in this research it should be found that *both* of the components of a double line were represented in the spectra of two different metals, and the suspicion of impurity were excluded, we should then indeed have a most powerful argument in favour of some identity of material or architecture in the molecules of the two substances involved.

Distortion of Solar Prominences by a Diffraction Spectroscope.—Generally, in such an instrument, the forms seen through the opened slit are either disproportionately extended, or compressed along the line of dispersion. The reason is this: if the slit be illuminated by monochromatic light, the image of the slit, formed on each side of the simple reflected image in the focus of the view-telescope (which is supposed to have the same focal length as the collimator), will have the same width as the slit itself only in one special case, not usually realised with a reflecting grating.

If the angle, between the normal to the grating and the view-telescope, is *less* than that between the normal and the collimator, the slit image will be *narrower* than the slit, and a prominence seen through it will be *compressed* in the plane of dispersion. If the relation of the angles be reversed, then of course the distortion will also be reversed, and we shall have extension instead of compression.

The mathematical theory is very simple. Suppose the collimator and telescope to be fixed at a constant angle, as in the now usual arrangement.

Let angle between telescope and collimator $= a$.

Angle between telescope and normal to grating $= \tau$.

Then angle between collimator and normal $= \kappa = a - \tau$.

Also, let space between adjacent lines of grating $= s$

And the order of spectrum observed $= n$

Then, by principles of spectrum formation, we have

$$\lambda = \frac{s}{n}\left\{\sin\tau - \sin\kappa\right\},$$

λ being the wave-length of the ray which is in the centre of the field of view

whence $$\sin\tau = \frac{n\lambda}{s} + \sin\kappa.$$

Differentiating, we have at once

$$d\tau = \frac{\cos\kappa}{\cos\tau}d\kappa, \text{ or } \frac{\cos(a-\tau)}{\cos\tau}d\kappa,$$

which reduces to, $d\tau = (\cos a + \sin a \tan\tau)\, d\kappa$. Distortion can only disappear in cases when this coefficient of $d\kappa$ reduces to unity. Special cases—

1. If $\tau = \kappa$ there is no distortion—but also no dispersion: it is the case of simple reflection.
2. If $\kappa = 0$, the grating being kept normal to the collimator, then $d\tau = \sec a\, d\kappa$.
3. If $\tau = 0$, the grating being kept normal to the telescope (which in this case must be movable), then $d\tau = \cos a\, d\kappa$.
4. If $a = 90°$, $d\tau = \tan\tau\, d\kappa$.
5. If $a = 0$, $d\tau = d\kappa$, and there is no distortion.

This is possible only by using the same tube and object-glass both for collimator and view-telescope, the grating being slightly inclined at right angles to the plane of dispersion. The principal difficulty in this form of instrument lies in the diffuse light reflected by the surfaces of the object-glass. It is hoped that this may be nearly obviated by a special construction of the lens which will throw the reflected light outside of the eyepiece. An instrument on this plan is being made for Prof. Brackett by the Clarks, for use in the physical laboratory at Princeton, and is now nearly completed.

Princeton, September 27, 1880 C. A. YOUNG

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

DR. J. E. HARRIS (D.Sc. Lond.) has been appointed to the vacant Professorship of Natural Philosophy at Trinity College, London.

FROM the new Calendar of the University College of Wales we learn that the present number of students is fifty-seven. We see there are classes for most of the branches of science, only unfortunately they are all taught by one professor, which, to say the least, must be rather hard on him. We hope the college will soon be able to have separate teachers, at any rate for the physical and biological sciences.

THE new University Library at Halle has just been opened. It is built entirely on the French system, and special precautions have been taken with regard to fire. It now numbers some 200,000 volumes, but there is room for half a million. The cost of the building amounts to 400,000 marks (20,000*l*.).

SCIENTIFIC SERIALS

THE *American Naturalist* for December, 1880, contains:—D. Cope, on the extinct cats of America.—F. V. Hayden, Twin

lakes and Teocalli Mountain, Central Colorado, with remarks on the glacial phenomena of that region.—C. E. Bessey, sketch of the progress of botany in the United States in the year 1879.—C. S. Minot, sketch of comparative embryology, No. 5, on the general principle of development.—The Editor's Table.—Permanent exhibition of Philadelphia.—Recent literature.—A new edition of Packard's "Zoology" is announced.—General Notes. Scientific news. Proceedings of scientific societies.

Revue des Sciences Naturelles, December, 1880, contains Herborisations of Strobelberger about Montpellier in 1620, translated, with notes, by M. Kieffer (a complete *exposé* of the extraordinary plagiarism of Strobelberger, who copied his work on the plants of Montpellier almost *verbatim* from the work of Lobel).—M. Doumet-Adanson, on an immense Calamary taken near Cette, January, 1880 (*Ommastrephes sagittata*). This specimen was nearly six feet in length, from the end of the body to the tops of the arms.—M. S. Jourdain, on the late development of scales in the eels.—E. Dubrueil, catalogue of testaceous mollusca collected from the French shores of the Mediterranean.—M. Reitsch, an analysis of Falkenberg's researches on the fecondation and alternation of generation in Cutleria.—F. Fontannes, on the stratigraphical position of the Pliocene group of Saint Aries, in the Western Bas-Dauphiné, and particularly in the environs of Hauterives (Drôme).—Scientific Reports and Bulletin.

Gegenbaur's morphologisches Jahrbuch, Band 6, Heft 4.—Dr. M. v. Davidoff, contribution to the comparative anatomy of the posterior limb masses in fishes, 2nd part (Plates 21, 23); Dr. W. Pfitzner, on the epidermis in the amphibia (Plates 24, 25); J. E. V. Boas, on the conus arteriosus in *Butirinus albula* and in other Teleostei (Plate 26); Dr. H. Rabl-Ruckhard, on the mutual relations between the chorda, hypophysis and the middle ridge of the skull in the embryos of the sharks', &c., brains (with Plates 27, 28); Carl Rabl, on the "pedicle of invagination," &c., in Planorbis (Plate 29); Prof. R. Wiedersheim, on the duplication of the os centrale in the carpus and tarsus of Axolotl (Plate 30); Prof. C. Gegenbaur, critical remarks on polydactylism as atavism; short notices; W. Leche, on the morpology of the pelvic region in the Insectivora.

Archives des Sciences Physiques et Naturelles, December 15, 1880.—Tertiary man in Portugal, by M. Choffat.—Monograph of the ancient glaciers and the erratic formation of the middle part of the Rhone valley, by MM. Falsan and Chantre.—Organic dust of the atmosphere, by Dr. Yung.—On the question of lowering of the high waters of the Lake of Constance, by M. Achard.

SOCIETIES AND ACADEMIES

London

Royal Society, January 6.—Observations on the Structure of the Immature Ovarian Ovum in the Bird and Rabbit, and on the Mode of Formation of the Discus Proligerus in the Rabbit and of the "Egg-Tubes" in the Dog. By E. A. Schafer, F.R.S.

The first part of the paper is devoted to a minute description of the young ovarian ova of the bird as seen in sections of the ovary of a laying hen. The germinal spot is described as composed of two distinct substances, namely, a homogeneous matrix staining but slightly with logwood and a number of coarse granules imbedded in it, which become darkly stained. The germinal spot may often be seen to be connected with the wall of the germinal vesicle by a network of fine filaments (intranuclear network). Appearances are also described which indicate that two germinal vesicles may be originally present in one ovum (? formed by the fusion of two primitive ova), and that one of the two may afterwards disappear.

A network of filaments is also described as existing in the yolk, which in some ova shows peculiar condensations of vitelline substance, which simulate nuclei, but the origin and meaning of these are left in doubt. Other appearances, as of systems of striæ, are also mentioned as occurring in larger ovarian ova. With regard to the membranes of the ovum the author differs from Waldeyer and agrees with Balfour in regarding the *zona radiata* as a product of the protoplasm of the ovum, and not as derived from the cells of the follicular epithelium.

The ovarian ovum of the rabbit is next described, and is found to agree in most essential particulars with that of the bird. The *zona pellucida* is porous, and allows granules of food-material to pass from the epithelium cells of the Graafian follicle directly into the vitellus. But it is chiefly in this epithelium that the interest centres, for the inner layer of cells of the follicular epithelium appears to be formed in the peripheral layer of the vitellus of the ovum itself, making their appearance first of all as mere nuclei (derived in all probability from the nucleus of the ovum), around which part of the protoplasm or vitellus of the ovum becomes segmented off. This description is compared with that which Kuppfer gives of the formation of an inner layer of follicular epithelium from nuclei which make their appearance in the periphery of the vitellus of the ovum of *Ascidia canina*, and with the observations of Kleinenberg upon the formation of a layer of cells from the periphery of the ovum of *Hydra*.

Finally the gland-like nature of the ovarian tubes in the bitch's ovary is insisted upon in agreement with Pfluger and Waldeyer, and in opposition to the view taken by Foulis.

January 13.—"On the Forty-eight Co-ordinates of a Cubic Curve in Space," by William Spottiswoode, President R.S.

In a note published in the *Report* of the British Association for 1878 (Dublin), and in a fuller paper in the *Transactions* of the London Mathematical Society, 1879 (vol. x. No. 152), I have given the forms of the eighteen, or the twenty-one (as there explained), co-ordinates of a conic in space, corresponding, so far as correspondence subsists, with the six co-ordinates of a straight line in space. And in the same papers I have established the identical relations between these co-ordinates, whereby the number of independent quantities is reduced to eight, as it should be. In both cases, viz., the straight line and the cubic, the co-ordinates are to be obtained by eliminating the variables in turn from the two equations representing the line or the conic, and are, in fact, the coefficients of the equations resulting from the eliminations.

In the present paper I have followed the same procedure for the case of a cubic curve in space. Such a curve may, as is well known, be regarded as the intersection of two quadric surfaces having a generating line in common; and the result of the elimination of any one of the variables from two quadric equations satisfying this condition is of the third degree. The number of coefficients so arising is $4 \times 10 = 40$, but I have found that these forty quantities may very conveniently be replaced by forty-eight others, which are henceforward considered as the co-ordinates of the cubic curve in space.

The number of identical relations established in the present paper is thirty-four. But it will be observed that the equations are lineo-linear in each of two groups, say the U-co-ordinates and the U′-co-ordinates, and as we are concerned with the ratios only of the coefficients, and not with their absolute values, we are, in fact, concerned only with the ratios of the U-co-ordinates *inter se*, and the U′-co-ordinates *inter se*, and not with their absolute values. Hence the number of independent co-ordinates will be reduced to $48 - 34 - 2 = 12$, as it should be.

Mathematical Society, January 13.—S. Roberts, F.R.S., president, in the chair.—Miss C. A. Scott and Messrs. J. Parker Smith, O. H. Mitchell, Fellow of Johns Hopkins University, and T. Craig, U.S. Coast Survey Office, Washington, were elected members. Dr. Hirst, in drawing attention to the loss the Society had sustained by the death of M. Chasles, gave a rapid sketch of that distinguished geometer's career and work, in lightly touching upon his private life he mentioned how gratified M. Chasles had been by the fact that he was not only the first Foreign Member of the Society, but for a long time the only one. The following communications were made:—On an apparently paradoxical relation of the circle, parabola, and hyperbola, by A. J. Ellis, F.R.S.—A proof of the differential equation which is satisfied by the hypergeometric series, by the Rev. T. R. Terry.—On the periodicity of hyperelliptic integrals of the first class, by W. R. W. Roberts.—On the tangents drawn from a point to a nodal cubic, by R. A. Roberts.—Sur une propriété du paramètre de la transformée canonique des formes cubiques ternaires, by Signor Brioschi (Milan).—Note on a kinematical theorem connected with the rectilinear courses of two vessels sailing uniformly, by C. W. Merrifield, F.R.S.—A partition-problem connecting the angles of a triangle with the angles of the successive pedal triangles, by J. W. L. Glaisher, F.R.S.

Paris

Academy of Sciences, January 10.—M. Wurtz in the chair.—The following papers were read:—On the conditions

relative to the theoretic expression of the velocity of light, by M. Cornu —Crystalline substances produced from old medals immersed in the thermal waters of Baracci, commune of Olmeto (Corsica), by M. Daubrée. Some of these bronze medals had merely a dark patina resulting from superficial sulphuration. A few others had a thick crystalline crust, the substance being apparently a double sulphide of copper and tin (of which the nearest natural analogue would be stannine) The water, containing only 0 3 gr of mineral matters per litre, has chloride of sodium, sulphate of soda, and silica in predominance.—On the star-fishes dredged in the deep regions of the Gulf of Mexico and the Carribean Sea by the American ship the *Blake*, by M Perrier. The new collections raise the number of species from twenty-seven to seventy. A pretty large number are new generic types —On a class of linear differential equations, the coefficients of which are algebraic functions of the independent variable, by M. Appell —On the circulatory apparatus of isopod crustaceans, by M Delage.—Phylloxera in California, by M. de Lavignon. The old vine growers say they have always known it, and they do not regard it as introduced with plants from Bordelais Its effects are the same in kind as in France, but its progress is very slow by reason of absence (apparently) of the winged insect, quality of the soil (rich and deep), and the existence of an acarian parasite (*Tyroglyphus longior*) —The Inspector-General of Navigation reported on the variations of the Seine at Paris in 1880. The highest water was on January 4, the lowest on February 3 and 4 —On a process of astronomical observation for use of voyagers, &c. (continued), by M. Rouget —On the transformation of reciprocal directions, by M. Laguerre —On the size and variations of Purkinje's images, by M. Crouillebois. It is proved that the mechanism of the adaptation consists in a simultaneous modification of the curvature of the two faces of the crystalline lens —Thermo-regulator for high temperatures, by M D'Arsonval This is applicable up to 1200° at least A regulator like that before described has its space under the membrane connected by means of a capillary tube with a short hollow stem which can be opened or closed with a screw and is connected by two tubes with a mercury manometer, and an air reservoir (of glass or porcelain) to be put in the medium that is to be kept constant. For temperatures over 300° he opens the stem when 1 atm. has been reached, and so lets the manometer come back to zero before closing again. A new method of reading must then, of course, be adopted.—Investigation of gaseous compounds and study of some of their properties with the spectroscope, by MM. Hautefeuille and Chappuis. With the spectroscope one can follow the isomeric change of ozone into oxygen, and prove that its destruction does not give hyponitric acid Electrification of a dry mixture of nitrogen and oxygen, containing at least one-seventh of the former, gives a substance not before observed, and having a remarkable absorption-spectrum. It is thought to be *pernitric acid*, analogous to M Berthelot's *persulphuric acid*.—On bromides and iodides of phosphorus, by M Ogier —Rapid stoppage of the rhythmic contractions of the cardiac ventricles through occlusion of the coronary arteries, by MM Sée, Bochefontaine, and Roussy —On the application of anatomical examination of the blood to diagnosis of disease, by M Hayem. He gives two methods · examination of pure blood in a thin layer, of constant thickness, and examination of blood diluted with a special reagent The phenomena in certain diseases are described.—On the quantity of light necessary to perceive the colour of objects of different surfaces, by M Charpentier. For retinal surfaces $\frac{88}{1000}$ to $\frac{440}{1000}$ mm square the illumination necessary to make or perceive colour (once the luminous sensibility is obtained) was the same for each colour tried. It may, then, be said that for red, yellow, green, and blue the chromatic sensibility is independent of the retinal surface excited. Influence exerted by environment on the form, structure, and mode of reproduction of *Isoetes lacustris*, by M. Mer.—On the conservation of grain in closed reservoirs, by M Muntz. With renewal of air he found about ten times more CO_2 produced than in a closed vessel. The volume of CO_2 found in contact with air is always less than that of O absorbed. The O is chiefly fixed by fatty matters. Too dry grain, not giving much of an asphyxiating atmosphere, is liable to the ravages of insects The proportion of CO_2 increases rapidly with the degree of moisture. As the temperature is raised there is physiological combustion up to a point (about 50°), thereafter chemical. Anæsthetics, like sulphide of carbon, diminish, without stopping, the formation of CO_2.—On a simple means of bringing to life new-born infants in a state of apparent death, by M Gozard. He describes a successful application of M. Le Bon's suggestion for young asphyxiated animals, immersing in a water-bath heated 45° to 50°.—M Boutigny invited attention to the fact that boiling water projected on an incandescent surface instantly falls in temperature to 97° He attributes this cooling to work done in production of the spheroidal state'

BERLIN

Geographical Society, January 8 —Dr Nachtigal, president.—The President gave a sketch of the work of the Society's explorers for the past year. It was hoped that Dr. Lenz would have been present at the meeting, but he had been unable to leave St Louis in Senegal, as yellow fever prevailed there. After a long interval letters had been received from Dr. Buchner, dated February, May, and July last. He had been for six months in Mussumba in Muatà Janvo's kingdom, carrying on topographical, photographic, and natural history work. After sending most of his papers and collections to Angola he proceeded northwards, writing on July 1 from Muene Chikambo. Dr Nachtigal then referred to the East African Expedition, which, along with Capt Ramaeckers, has arrived at Tabora, and Dr Rohlfs' party, who on December 12 were at Massowah.—Herr Buchter exhibited a large number of photographs and drawings from the Upper Nile.

VIENNA

Imperial Academy of Sciences, January 7 – On the quantitative relations of electric expansion in glass and caoutchouc, by G Korteweg and V A. Julius.—Preliminary note on decomposition of water, by C. Baudet.—Researches on fats, by D G Goldschmiedt and M. v. Schmidt —On an uncrystallisable acid obtained from albumen by oxidation with permanganate of potash, by E v Bruecke

CONTENTS

THURSDAY, JANUARY 27, 1881

UNCONSCIOUS MEMORY

Unconscious Memory, &c. By Samuel Butler. Op. 5. (London: David Bogue, 1880.)

MR. BUTLER is already known to the public as the author of two or three books which display a certain amount of literary ability. So long therefore as he aimed only at entertaining his readers by such works as "Erewhon," or "Life and Habit," he was acting in a suitable sphere. But of late his ambition seems to have prompted him to other labours, for in his "Evolution, Old and New," as well as in the work we are about to consider, he formally enters the arena of philosophical discussion. To this arena, however, he is in no way adapted, either by mental stature or mental equipment, and therefore makes so sorry an exhibition that Mr. Darwin may well be glad that his enemy has written a book. But while we may smile at the vanity which has induced so incapable and ill-informed a man gravely to pose before the world as a philosopher, we should not on this account have deemed "Unconscious Memory" worth reviewing. On the contrary, as a hasty glance would have been sufficient to show that the book is bad in philosophy, bad in judgment, bad in taste, and, in fact, that the only good thing in it is the writer's own opinion of himself—with all that was bad we should not have troubled ourselves, and that which was good we should not have inflicted on our readers. The case, however, is changed when we meet, as we do, with a vile and abusive attack upon the personal character of a man in the position of Mr. Darwin; for however preposterous, and indeed ridiculous, the charges may be, the petty malice which appears to underlie them deserves to be duly repudiated. We shall therefore do our duty in this respect, and at the same time take the opportunity of pointing out the nonsense that Mr. Butler has been writing, both about the philosophy of evolution and the history of biological thought.

The great theory which Mr. Butler has propounded, and which with characteristic modesty he says seems to himself "one, the importance of which is hardly inferior to that of the theory of evolution itself"—this epoch-making theory is as follows. The processes of embryonic development and instinctive actions are merely "repetitions of the same kind of action by the same individuals in successive generations." Therefore animals know, as it were, how to pass through their embryonic stages, and, after birth, are taught by instinctive knowledge, simply because [as parts of their ancestral organisms they have done the same things many times before; there is thus a race-memory as there is an individual memory, and the expression of the former constitutes the phenomena of heredity.

Now this view, in which Mr. Butler was anticipated by Prof. Hering, is interesting if advanced merely as an illustration; but to imagine that it reveals any truth of profound significance, or that it can possibly be fraught with any benefit to science, is simply absurd. The most cursory thought is enough to show that, whether we call heredity unconscious memory, or memory of past states of consciousness the hereditary offspring of those states, we have added nothing to our previous knowledge either of heredity or of memory. All that lends any sense to the analogy we perfectly well knew before—namely, that in the race, as in the individual, certain alterations of structure (whether in the brain or elsewhere) when once made, tend to remain. But the analogy throws no light at all upon the only point which requires illumination—namely, how is it that, in the case of heredity, alterations of structure can be carried over from one individual to another by means of the sexual elements. We can understand in some measure how an alteration of brain structure, when once made, should be permanent, and we believe that in this fact we have the physical basis of memory; but we cannot understand how this alteration is transmitted to progeny through structures so unlike the brain as are the products of the generative glands. And we merely stultify ourselves if we suppose that the problem is brought any nearer to a solution by asserting that a future individual while still in the germ has already participated, say in the cerebral alterations of its parent—and this in a manner analogous to that in which the brain of the parent is structurally altered by the effects of individual experience. But Mr. Butler goes even further than this, and extends his so-called theory even to inorganic matter. He "would recommend the reader to see every atom of the universe as living, and able to feel and remember, though in a humble way." Indeed he "can conceive of no matter which is not able to remember a little"; and he does "not see how action of any kind is conceivable without the supposition that every atom retains a memory of certain antecedents." It is hard to be patient with such hypertrophied absurdity; but if the bubble deserves pricking, it is enough to ask how it is "conceivable" that an "*atom*," even if forming part of a living brain, could possibly have "a memory of certain antecedents," when, as an atom, it cannot be conceived capable of undergoing any structural modification.

So much for Mr. Butler's main theory. But he has also a great deal to say on the philosophy of evolution. "Op. 4" was called "Evolution, Old and New," and now "Op. 5" continues the strain that was struck in the earlier composition. This consists for the most part in a strangely silly notion that "the public generally"—including, of course, the world of science—was as ignorant of the writings of Buffon, Dr. Erasmus Darwin, and Lamarck as was Mr. Butler when he first read the "Origin of Species." That is to say, "Buffon we knew by name, but he sounded too like 'buffoon' for any good to come from him. We had heard also of Lamarck, and held him to be a kind of French Lord Monboddo; but we knew nothing of his doctrine. . . . Dr. Erasmus Darwin we believed to be a forgotten minor poet," &c. No wonder, therefore, when such was our manner of regarding these men, that we required a Mr. Samuel Butler to show us our error. And no wonder that Mr. Charles Darwin, who doubtless may have peeped into the literature which Mr. Butler has discovered, should so well have succeeded in his life long purpose of concealing from the eyes of all men how much he owes to his predecessors. No wonder, also, that Mr. Darwin, when he chanced to see an advertisement of a forthcoming work by Mr. Butler with the title "Evolution,

Old and New," should have inferred, as Mr Butler observes, "what I was about," and forthwith began to tremble in dismay that at last the Buffoon, the French Lord Monboddo, and the forgotten minor poet had found a champion to vindicate their claims For now the hideous corruption of the monster was about to be exposed who had fed as a parasite upon these "dead men," till he stands before our eyes bloated with honours undeserved, and extending "his power of fascination all over Europe," not only "among the illiterate masses . . but among experts and those most capable of judging" No wonder then that Mr. Darwin, knowing that at last a wise young judge had come to judgment and to open the eyes of the "experts," should at once have set about a book on his own grandfather to disarm by anticipation the justice of the avenger But natural as all this unquestionably appears, it scarcely prepares us, as it did not prepare Mr Butler, for the depths of deceit and depravity to which Mr Darwin would "condescend" in order to thwart the arm of justice Yet the fact is that Mr Darwin entered into a foul conspiracy with Dr Krause, the editor of *Kosmos*, to slay by infamous means the righteous but damning work of Mr Butler "The steps," as he points out, "are perfectly clear" A whole number of *Kosmos* was devoted to Mr Darwin and his antecedents in literature, at about the time when "Evolution Old and New" was "announced" as in preparation Soon afterwards arrangements were made for a translation of Dr Krause's essay, and were completed by the end of April, 1879 Then "Evolution Old and New" came out, was read by Dr. Krause, who modified a passage or two in a manner that "he thought would best meet 'Evolution Old and New,' and then fell to condemning that book in a *finale* that was meant to be crushing" So far all was fair enough, but now comes the foul play "Nothing was said about the revision which Dr Krause's work had undergone, but it was expressly and particularly declared in the preface that the English translation was an accurate version of what appeared in the February number of *Kosmos*, and no less expressly and particularly stated that my book ["Evolution Old and New"] was published subsequently to this Both these statements are untrue," &c Having discovered this erroneous conspiracy, Mr Butler wrote to Mr Darwin for an explanation With almost incredible complacency this arch-hypocrite had the hardihood to answer that it "is so common a practice" to modify articles in translation or republication, that "it never occurred to him to state that the article had been modified," but that now he would do so should there be a reprint This, as Mr Butler says, "was going far beyond what was permissible in honourable warfare, and it was time in the interests of literary and scientific morality, . . . to appeal to public opinion." He therefore communicated the facts to the *Athenæum*, expecting as a consequence to raise a "raging controversy" Strange to say, however, the thing fell flat. "Not only did Mr Darwin remain perfectly quiet, but all reviewers and *littérateurs* remained perfectly quiet also It seemed . . as if public opinion rather approved of what Mr. Darwin had done." Nevertheless Mr. Butler had a salve to his disappointment in that he saw "the 'Life of Erasmus Darwin' more frequently and more prominently advertised than hitherto," and "presently saw Prof Huxley hastening to the rescue with his lecture 'On the Coming of Age of the Origin of Species'" Truly, therefore, in some, if not quite in full measure, Mr Butler's "vanity," as he himself observes, "was well fed by the whole transaction", for he saw by it that Mr. Darwin "did not meet my work openly," and therefore that Prof Huxley had to "hasten to the rescue" with a Royal Institution lecture. How sweet it doubtless was, if Mr Butler attended that lecture, to think what a large proportion of the audience must have seen through the whole plot! Enough, surely, to "feed" any ordinary "vanity" But Mr Butler's vanity is inordinate, and so requires a more than ordinary amount of nourishment He therefore felt it desirable to give a detailed exposition of the whole affair, and this we have in some charmingly temperate and judicious chapters of "Op 5"

But to be serious If in charity we could deem Mr. Butler a lunatic, we should not be unprepared for any aberration of common-sense that he might display. His "Op 5," however, affords ample evidence that he is not a lunatic, but a man who wants to make a mark somewhere, and whose common sense, if he ever had such a thing, has been completely blinded by self-conceit. To us, no less than to him, "the steps are perfectly clear" A certain nobody writes a book accusing the most illustrious man in his generation of burying the claims of certain illustrious predecessors out of the sight of all men. In the hope of gaining some notoriety by deserving and perhaps receiving a contemptuous refutation from the eminent man in question, he publishes this book, which, if it deserved serious consideration, would be not more of an insult to the particular man of science whom it accuses of conscious and wholesale plagiarism, than it would be to men of science in general for requiring such elementary instruction on some of the most famous literature in science from an upstart ignoramus who, until two or three years ago, "considered" himself "a painter by profession" The eminent man however did not administer the chastisement hence these tears of rage and chagrin, hence too the morbid fancying of the great man's discomfort—of the rallying round of his friends, Krause's article, Huxley's lecture, &c, till such an explosive state of feeling was fermented that a mere omission to supply a reference to a book was magnified into a dark conspiracy—notwithstanding that a moment's thought might have shown how such a conspiracy, even if attempted, would not have been worthy of imbeciles

But, in conclusion, let us ask what this work on "Evolution, Old and New" contained to produce, as its author imagines, such a scare among the leading "experts" in science The work has already been reviewed in these columns (June 12, 1879) by Mr Wallace, who, while fully exposing its weakness, treats the author with more consideration than he deserves—doubtless because Mr Wallace is himself so personally associated with the theory of "natural selection" It is therefore sufficient for us here to say that "Evolution, Old and New," conveys a confession on the part of its author that until two or three years ago he was totally ignorant concerning the history of biological thought His attention having at length been directed to the fact that some of

the best naturalists had speculated on the probability of evolution, he for the first time found, as he innocently enough observes, that evolution and natural selection are not quite the same thing. Having made this highly original discovery, he forthwith proceeds to display a feebleness of judgment even more lamentable than his previous ignorance For he concludes that the older speculations on the causes of evolution are more satisfactory than those advanced by Mr. Darwin In the columns of a scientific journal any comment on such a conclusion might well be deemed superfluous, although Mr. Wallace, in his review above mentioned, had the courtesy to expose its folly The older evolutionists deserve indeed all honour for having perceived early in the day that some theory of descent must be true, even though they were not able to find the theory that could be seen to be in any measure satisfactory But a man who in the full light of Darwin's theory can deliberately return to "the weak and beggarly elements" of Lamarck—such a man only shows that in judgment he is still a child The extreme weakness of Mr Butler's argumentation has, as we have said, already been shown by Mr Wallace, but it is of more interest to ask what infatuation it can have been that led him to suppose "all Europe and those most capable of judging" required him as an author to make himself ridiculous as an expounder of this subject The answer is not far to seek As Mr. Butler himself has told us, he has vanity, and his vanity is not less childish than his judgment Thus, to give only one illustration Of so much importance does he deem his own cogitations, that in the book we are reviewing he devotes two chapters, or more than thirty pages, to "How I wrote 'Life and Habit,'" and "How I wrote 'Evolution, Old and New'", entering into a minute history of the whole course of his speculative flounderings This is the only part of the book that repays perusal, but that this part well repays perusal may be judged from the following, which we present as a sample --

"The first passage in 'Life and Habit' which I can date with certainty is one on p 52, which ran as follows . . '"Do this, this, this, which we too have done, and found our profit in it," cry the souls of his forefathers within him Faint are the far ones, coming and going as the sound of bells wafted on to a high mountain, loud and clear are the near ones, urgent as an alarm of fire' This was written a few days after my arrival in Canada, June 1874 I was on Montreal Mountain for the first time, and was struck with its extreme beauty . Sitting down for a while, I began making notes for 'Life and Habit,' of which I was then continually thinking, and had written the first few lines of the above, when the bells of Nôtre Dame in Montreal began to ring, and their sound was carried to and fro in a remarkably beautiful manner I took advantage of the incident to insert then and there the last lines of the piece just quoted I kept the whole passage with hardly any alteration, and am thus able to date it accurately Early in 1876 I began putting these notes into more coherent form I did this in thirty pages of closely-written matter, of which a pressed copy remains in my commonplace-book I find two dates among them—the first 'Sunday, February 6, 1876'; and the second, at the end of the notes, 'February 12, 1876.'"

This historical sketch, which is without the smallest interest to any one but Mr Butler himself, winds up with the following burst of eloquence.—

"Here, then, I take leave of this matter for the present. If it appears that I have used language such as is rarely seen in controversy, let the reader remember that the occasion is, so far as I know, unparalleled for the cynicism and audacity with which the wrong complained of was committed and persisted in I trust, however, that, though not indifferent to this, my indignation has been mainly roused, as when I wrote 'Evolution, Old and New,' before Mr Darwin had given me personal ground of complaint against him, by the wrongs he has inflicted on dead men, on whose behalf I now fight, as I trust that some one—whom I thank by anticipation—may one day fight on mine"

Mighty champion of the mighty dead! When our children's children shall read in Westminster Abbey the inscription on the tomb of Mr Samuel Butler, how will it be with a sigh that in their day and generation the world knows nothing of its greatest men! But as it is our misfortune to live before the battle over Mr Samuel Butler's memory has been fought, we respond to his abounding presumption by recommending him, whatever degree of failure he may have experienced in art, once more to "consider" himself "by profession a painter"—or, if the painters will not have him, to make some third attempt, say among the homœopathists, whose journal alone, so far as we are aware, has received with favour his latest work GEORGE J ROMANES

NEWTON'S BRITISH BIRDS

A History of British Birds By the late William Yarrell, V P L S, F Z S Fourth Edition, revised by Alfred Newton, M A, F R S Part 10, November, 1876, 11, September, 1877, 12, October, 1878, 13, June, 1880 (London Van Voorst)

WE call this work advisedly "Newton's British Birds," although the title-page would seem to signify that it is only a fourth edition of Yarrell's well-known "History" It is however in fact a new book. The text has been completely rewritten, and the familiar woodcuts and vignettes alone remain to remind one of the former author

The parts of Prof Newton's work now before us conclude the account of the Passeres and contain the commencement of the history of the British Picariæ We need hardly say that the article upon each species is worked out in the same careful and accurate way as in the former portion of this work Prof Newton, as every ornithologist knows, is our leading authority on this subject, which, during a course of many years of constant attention, he has made specially his own We observe with great pleasure the elaborate manner in which the distribution of each species is described, not only within the area of the British Islands, but also wherever it is known to occur on other parts of the world's surface We may likewise notice the entire absence of misprints and the excellence of the type and paper, which do credit alike to the author and publisher, and will no doubt greatly contribute to extend the circulation of the work. Having said thus much, it is with regret that we must add one word of discontent, for which we trust Mr Van Voorst and Prof Newton will alike forgive us The rate of issue of the numbers is so slow that it is difficult to calculate when the new edition will be completed. As will be seen by the heading of the article, only four parts

have been published during the four past years If, as we suppose, about twenty more parts are required to finish the work, it is manifest that unless the present rate of progress be expedited it will be twenty years before we are able to send our new "History of British Birds" to the binders The edition was commenced, we believe, in 1871 Now thirty years seems rather long for the execution of a new edition of any work, even with all the improvements which, as we have shown above, the present editor has doubtless bestowed upon it We would fain ask therefore whether the author and publisher cannot manage to move on a little faster If this cannot be done it appears to us that the first portion of the work will be almost out of date before the last part is published, and that the subscribers will have good reason to complain

OUR BOOK SHELF

Jahrbucher fur wissenschaftliche Botanik. Herausgegeben von Dr N Pringsheim Elfter Band, drittes und viertes Heft With twenty-four plates. (Leipzig W Engelmann, 1877 and 1878)

DR JAKOB ERIKSSON describes in a lengthened paper the protomeristem of the roots of Dicotyledons, and directs attention to the four great types of structure observable in these roots In the first type the apex consists of three separate zones of meristem the plerome, periblem, and dermocalyptrogen. In the second type only two zones are present the plerome and a common zone for primary cortex, epidermis, and root-cap In the third type there is a common meristem zone from which all the others develop, while in the fourth there are two zones, the periblem and the plerome Two additional types are met with in Monocotyledons (1) in which there are four zones of meristem calyptrogen, dermatogen, peroblem, and plerome, and (2) in which there are three zones the calyptrogen, the plerome, and a common zone for cortex and epidermis

The germination of Equisetum and Schizæaceæ forms the subject of two papers, one by Sadebeck and the other by Bauke, whose work was arrested by premature death Woronin contributes a paper on the *Plasmodiophora Brassicæ*, the remarkable Myxomycete which seems to be the cause of the so-called Hernia of the cabbage plant, which has recently attracted so much attention

The remaining papers are by Reinke, on *Monostroma bullosum* and *Tetraspora lubrica* Wydler discusses at great length the morphology of certain forms of inflorescence, chiefly dichotomous, and lastly there is a paper by Pitra on the pressure in stems during the appearance of bleeding in plants The contents of the parts are, as will be seen, very varied and deal with many different departments of botany, and will be found to sustain the reputation of the "Jahrbucher" so long associated with the name of Pringsheim

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

The Editor urgently requests correspondents to keep their letters as short as possible The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Unconscious Memory—Mr. Samuel Butler

WILL you kindly allow me a portion of your valuable space in order that I may demonstrate the completely groundless character of a series of insinuations which Mr Samuel Butler has made not only against myself, but also against Mr Charles Darwin, in the work which he has recently published, entitled "Unconscious Memory" (Op. 5).

1. Mr. Butler insinuates that Mr. Darwin caused my essay on Dr Erasmus Darwin to be translated simply in order to throw discredit on his work, "Evolution, Old and New" (Op 4), which was published in May, 1879. Upon this point I have to observe that Mr. Darwin informed me of his desire to have my essay published in English more than two months before the appearance of Mr Butler's book, that the translation did not appear earlier is due to the fact that I asked for a delay in order that I might be able to revise it

2 The assumption of Mr. Butler that Mr. Darwin had urged me to insert an underhand attack upon him (Mr Butler) in my sketch, is not only absolutely unfounded, but, on the contrary, I have to state that Mr. Darwin specially solicited me *to take no notice whatever* of Mr. Butler's book, which had in the meantime appeared Since however I thought it desirable to point out that Dr Erasmus Darwin's views concerning the evolution of animated Nature still satisfy certain thinkers, even in our own day (a fact which must add greatly to Dr Darwin's reputation), I have made some remarks upon the subject in a concluding paragraph, without however naming Mr Butler And I may here emphatically assert, that although Mr Darwin recommended me to omit one or two passages from my work, he neither made nor suggested additions of any kind

3 Mr. Butler's assertion that the revision of my translation was made "by the light" of his book is only in so far justifiable that I looked over the latter before sending off my work, and that my attention was thereby called to a remark of Buffon's. From Mr Butler's book I have neither taken nor was I able to take the slightest information that was new to me concerning Dr Erasmus Darwin's scientific work and views, since in it practically only one portion of the "Zoonomia" is discussed at any length, and this portion I had already quoted and analysed, while Mr Butler only refers to one comparatively unimportant part of the "Botanic Garden," and absolutely ignores the "Phytologia" and the "Temple of Nature" So that no *single line* of Mr. Butler's far from profound work was of the slightest use to me

Mr Butler's contention that I have quoted from his book a remark from Coleridge is entirely without foundation I have been acquainted with this remark for years, and from the source quoted It is also quoted in Zoeckler's work (vol ii p 256), mentioned by me on p 151, which appeared *prior* to Mr Butler's book (Op. 4). The whole of my indebtedness to Mr Butler reduces itself therefore to a single quotation from Buffon

4 Finally, as concerns the main accusation that no mention is made in the preface of the fact that my essay had been revised previously to publication, it is clear, as even a child could not fail to see, that this is not due to design, but is simply the result of an oversight. It would be simply absurd for a writer intentionally to attack a publication which appeared subsequently to the date indicated on his title-page; and the so-called falsification, so far from injuring Mr Butler, could only be most agreeable to him, because it might induce the careless reader to fancy that no reference whatever was intended to Mr. Butler in the closing sentence. Should however such a reference be clearly intended—and to every reader posted up in the subject this could not be doubtful—every man of common sense would recognise this terrible falsehood to be a simple oversight.

Berlin, January 12 ERNST KRAUSE

Hot Ice

I VENTURE, in referring to Dr Lodge's letter of this week, to put before your readers the meaning of the remarks made on Dr. Carnelley's experiment at the Chemical Society by Prof Ayrton, who is now away from England. I understood him to say that as Dr. Carnelley's hot ice is obviously in a condition which cannot be represented within the as yet known fundamental water surfaces, it is necessary to produce these surfaces beyond the places at which, hitherto, abrupt changes have been supposed to take place in them. He took as an instance the *ice-water* surface which has hitherto been assumed to stop at Prof. James Thomson's "triple point," and showed that although Sir Wm. Thomson's experiments have proved that it is nearly plane for the stable state of water and ice, yet in the imaginary district beyond the triple point a change of latent heat might give such a change of curvature as to bring this surface into the hot-ice region.

With Prof. Ayrton I have done for water what Prof. James Thomson did for carbonic acid, we constructed in stiff paper a surface or surfaces which represent the relations of p, v and t for a given quantity of water-stuff. Three parts of the whole are cylindric surfaces and divide space into three regions, in one of them the substance is in the form of ice, in another in the form of water, in another in the form of vapour; and they meet in Thomson's triple point. Any one looking at this model must feel that Prof. Ayrton was right in looking for the hot-ice state in a region bounded by imaginary productions of the *all ice*, the *all-water*, the *all-vapour*, and the above mentioned three cylindric surfaces beyond their lines of intersection. This is what Prof. James Thomson did to indicate the state of water before boiling by bumping begins. He assumed that the *all water* surface changed into the *all-vapour* surface gradually, and not through a purely cylindric *water-vapour* surface, and this is really what Dr. Lodge himself does for hot ice. That is, he imagines the *all-ice* surface to change into the *all-vapour* surface gradually, and not by sudden changes through a purely cylindric *ice-vapour* surface. According to Mr. Ayrton the imaginary production is even of a more complicated kind than Dr. Lodge supposes, as the ice probably changes into unstable water before it changes into steam. There can be no doubt that such imaginary productions find their place in the fundamental equation of water, but I cannot agree with Dr. Lodge in thinking that we have at present an explanation of such unstable conditions. If his explanation were satisfactory we ought to be able in the same way to explain the unstable position which precedes boiling by bumping, and this we cannot do. Where the explanation seems to me to fail is in the assumption that the hot vapour filling a cavity, being of lower temperature than the surface of the cavity, is always at a pressure less than that of saturation, in spite of the evaporation going on. Now when we consider how large the surface of a minute cavity is as compared with its volume, the very great increase in bulk when the solid is changed into vapour and the lowering of temperature which the surface must undergo on account of latent heat, we see that the condition which Dr. Lodge assumes to be maintained during the whole experiment would be instantaneously destroyed in a very minute cavity. In explaining hot ice I am afraid that neither Prof. Ayrton nor Dr. Lodge has given us more than Prof. James Thomson has given in explaining "boiling by bumping." The cause of the phenomenon is a molecular one probably, and must be left to the guesses of molecular physicists. JOHN PERRY

14, Talgarth Road, West Kensington

Mr. Bottomley's Experiments with Vacuum Tubes and the Aurora

MR. BOTTOMLEY'S extremely interesting experiments briefly described in NATURE, vol. xxiii. pp. 218 and 243, appear to have a very important bearing on the question of atmospheric electricity, for if such high vacua are good conductors of electricity we have reason for thinking that the electrical conditions of our globe will be very different from what we have been accustomed to regard them. The layers of denser air surrounding the conducting matter of the globe will act like the glass of Mr. Bottomley's tubes in maintaining by a Leyden-jar-like action any difference of potential that there may be between their inner and their outer surface. Again, in the piercing of the glass tube by a minute spark, we have the analogue of the lightning flash between the clouds and the earth, the insulating layer in each case giving way, when, owing to an excessive increase in the surface density of the charge at any point, the dielectric stress exceeds the limits of the dielectric strength of the medium. The internal luminous effects observed by Mr. Bottomley as the result of change in the distribution of the external charge of electricity will be the physical analogues of the *aurora*, with this difference, that they take place in the ultra gaseous interior, whereas in the case of our globe the luminous phenomena take place in the ultra gaseous (*i.e.* highly rarefied) exterior regions of the atmosphere. It would be interesting to learn whether such discharges present any other analogies with auroral phenomena. I should be particularly interested in learning whether the conditions under which such luminous effects are obtained give any support to the theory which I think to be the only consistent one, that the aurora is due *not* to electrical discharges from regions of less atmospheric density to regions of a greater density (or *vice versâ*), but to electrical discharges in a region of pretty uniform (and small) density, and in which region differences of electric potential exist. According to this view the auroral streaks which appear to be radial should in reality lie approximately parallel to the earth's surface, and not stand (as most persons imagine) normal to it. A series of horizontal parallel lines drawn across the sky in a direction approximately north and south would necessarily appear to an observer on the earth's surface foreshortened into a set of lines diverging in fan like forms at either the north point or the south point of the horizon. Their divergence would therefore be apparent only, like the "beams" diverging from the sun at sunset on a cloudy day, or like the beams of the *rayons du crépuscule*, or like the "radial streaks" which I have pointed out as frequently accompanying rainbows. SILVANUS P. THOMPSON

University College, Bristol, January 22

P.S.—The behaviour of a hollow sealed glass tube containing a conducting substance in its interior was noticed just one hundred years ago by Cavallo, who sealed up a glass tube in which mercury was at its boiling point, thus obtaining a fairly perfect vacuum.—S. P. T.

The Geological Age of the North Highlands of Scotland

FROM the abstract of *Proceedings* of the Geological Society (January 5) I learn with surprise that Sir R. Murchison's interpretation of the succession of the beds over the region north of the Caledonian Canal is disputed, and that the relations of the fossiliferous limestone of Durness to the quartzites "are" (according to Dr. Callaway) "by no means satisfactorily established, and that their conformity is rendered dubious by a marked discordance of strike", in fact that the limestone lies in a synclinal basin amongst the quartzites, so that if the limestone be of Lower Silurian ("Arenig") age the quartzites and schists must be older; this I presume to be the inference Dr. Callaway intends to draw, as he says there "is no proof of the Lower Silurian age of the quartzite and newer series of flaggy gneiss and schist" constituting the interior mountainous district.

Having had an opportunity last spring of visiting the district lying between Lochs Broom and Inchard under the guidance of Prof. Geikie and in company with my colleague of the Irish Survey, Mr. Symes, I take the opportunity offered by Dr. Callaway's paper of expressing my entire concurrence in the interpretation of the structure of the country given by my late chief, whose elaborate and graphic descriptions in the pages of the *Quarterly Journal* of the Geological Society (vols. xv. and xvii.) will, I feel sure, never be invalidated.

After seeing the clear infra-position of the limestone to the upper quartzite and schists first in the section at the Bridge of Ault Corry near Ullapool, then in the cliffs near Ullapool, next at Inchnadamff and the head of Loch Assynt, then again in the Forest of Arkle and the hills bordering Loch Stack, where the limestone band is clearly interbedded between the lower and upper quartzites, and this latter as clearly passes under the schists of the interior, it required no further evidence to prove that all these beds belong to one conformable formation, and that the geological age of the whole group is determined by the fossils discovered by Mr. Charles Peach in the limestone of Durness or Assynt, and named by the late Mr. Salter. The geological sequence is so clear throughout that region, and so entirely bears out the description given by Murchison and Geikie, that "he who runneth may read" and I have no hesitation in saying that the evidence that the Millstone Grit overlies the Carboniferous Limestone, and that the New Red Marl overlies the New Red Sandstone is not more clear than that the upper quartzites and schists overlie the Assynt limestone.

I wish to point out in conclusion that the trough-shaped arrangement of the Durness limestone and its faulted position, described by Dr. Callaway, has already been described by Murchison in the *Quarterly Journal*, vol. xv. Any one visiting the grand tract of country lying between Durness and Loch Maree need have no better guide than the papers I have referred to, and a good geological map. He will find that there is little, if anything, to add to the details and conclusions there given, and were it not that Dr. Callaway's objections seem to find support with some geologists of more experience than himself, it would not have been necessary to enter a *caveat* against them.

As regards the question whether in any part of the Highlands of Scotland except along the western coast the Laurentian (or "pre-Cambrian") rocks reappear, as has been stated or suggested, I do not wish to offer an opinion. As regards the region

north of the Caledonian Canal, it seems to me that this is extremely improbable, as along the two traverses we made—one from Garve to Ullapool, the other from Laxford to Lairg—the prevalent dips are eastward, and the upper quartzites forming the elevations of Ben Dearig and Ben More are of great thickness. One may therefore assume that the Laurentian gneiss (even in the absence of the Cambrian sandstone) is deeply buried beneath these beds and their succeeding schists. The region of the Grampians of Aberdeenshire, on the other hand, is of great extent, and until it has been explored by the officers of the Geological Survey it would be injudicious (as it appears to me) to come to any opinion on the subject. EDWARD HULL

Geological Survey Office, Hume Street, Dublin, January 18

Geological Climates

HAVING considered the effects of Mr Wallace's proposed redistribution of land and water, intended to raise the mean annual temperature of Bournemouth 15° or 20° F above its present amount, I now, with your permission, shall say a few words on some minor questions, which have arisen during our discussion of the difficult problem of Geological Climates

1 *The Clump of Bamboos at Cooper's Hill Engineering College* —Prof McLeod has kindly forwarded me a specimen of the foliage of the bamboo now growing in his garden, and has promised to send me the fruit when it ripens

My botanical friends cannot decide its species, with certainty, from the foliage alone, without the seeds, but think that it, probably, is the bamboo called *Thamnocalamus Falconeri*, formerly called *Arundinaria falcata* (not *Arundinacea*) and also called *Bambusa gracilis*. If this opinion be correct my rejection of its evidence in favour of Cooper's Hill now having the climate of "torrid India" was also correct, for this bamboo is one of the hardiest of the "hardy bamboos" growing in the Himalayas, as high as the limit of perpetual snow, and being exposed, at night and in winter, to extremes of cold, which are never experienced in the British Islands Whether our summers are hot enough to ripen its seeds, and fully acclimatise it amongst us, remains to be seen

It is a suggestive fact that at Fota, in the Cove of Cork, where it grows in clumps 20 feet in circumference, from each of which spring over 400 canes reaching a height of 25 feet, the seeds ripen with difficulty and take a long time to germinate, some two months elapsing before they come through the soil, even in a temperature of 70° F

2 *The Moreton Bay Pine at Bournemouth* —Mr William Ingram's letter, stating that an individual of this species, surrounded with "wooded heights" about it, has lived for forty years in Leicestershire, and attained a height of 35 feet, shows what the gardener's skill can accomplish in protecting a sub-tropical tree from the injurious effects of English winters, but throws no light whatever upon the possibility of the Moreton Bay pine living spontaneously in this country

In order to do so it must ripen its fruit and produce seedlings, which (as I am informed) it cannot possibly do with the moderate heat of our cool summers

3 *Tertiary Climates in England* —Mr Gardner states, that independently of the evidence afforded by the Moreton Bay pine, the Tertiary fossil plants of the Eocene require an increase of temperature of, at most, 20° F.

When we add to this that the London clay contains true *Crocodiles*, true *Palms*, many species of *Nautilus*, of *Volutes*, and large species of *Cypræa*, we may be certain that 20° F. increase of temperature is the very minimum required

The question of importance is, whence did this required heat come from? This is a question of number and magnitude, and not of mere "naturalist talk" This question cannot be settled by redistributions of land and water, nor by repeating continually the assertion that all former causes of change of climate were the same as existing causes, not only in kind, but in degree

SAMUEL HAUGHTON

Trinity College, Dublin, January 14

I AGREE with Prof. Haughton in his conclusion that no increase in the quantity of water sent into the Arctic Ocean by currents like the Gulf Stream would make much practical difference in the Arctic climate, though not altogether for his reasons. I think the question of total quantities of heat is irrelevant, and that the extent of glaciation and the distribution of plants and animals are almost exclusively determined by summer temperatures

Respecting the distribution of plants and animals, I believe this is the general testimony of naturalists, and it is certainly confirmed by Nordenskjold's observations on the Siberian flora Respecting glaciation, I rely for proof on the well known fact that the extent of perpetual snow on mountains—in other words, the height of the snow-line—depends, not on mean temperature, but on summer temperature

If this is true it shows that no change in the ocean currents would make much difference; for a glance at Dove's isothermal lines for July and January shows that the effect of the Gulf Stream on the temperatures of Europe and Asia and the Arctic Ocean is chiefly confined to winter The late Mr Hopkins, in his well known paper on changes of climate (Geological Society, December, 1851) estimated that the effect of the Gulf Stream on the July climate of London is null.

JOSEPH JOHN MURPHY

Old Forge, Dunmurry, Co Antrim, January 17

Prof Whitney on the Glaciation of British Columbia

IT must be gratifying to all geologists interested in the western part of America to find that a portion of the general results of the work of the California Survey is at length being published under the auspices of the Museum of Comparative Zoology at Harvard College, Prof. Whitney's "Auriferous Gravels of the Sierra Nevada" being now supplemented by the first part of a volume on the "Climatic Changes of Later Geological Times," dealing chiefly with the evidences of glaciation on the Pacific slope No one will question Prof Whitney's observations and deductions on this subject when he deals with that portion of the region with which he is personally familiar, especially as these are in substantial agreement with the already published facts of Clarence King. The general result arrived at in the areas of Whitney's and King's surveys is that comparatively only a very small portion of the highest ranges of mountains has ever been covered with glaciers, and that there has never been in this region anything like a northern drift period or a transportation of material in any given direction independent of the present topographical features of the country

This accords also with the statement published by Prof Whitney in 1866 (*Proc* Cal. Acad Sci vol iii p 271) as to the absence of glacial traces of a general character from California, but—as it appears to me unfortunately—a clause was added to this statement embracing in the generalisation the whole north western extension of the Cordillera region Now in 1866, as Prof Whitney himself says, almost nothing was definitely known of the coast north of Oregon, and for that portion of it included in the province of British Columbia I have since maintained, as the results of observation, that there is conclusive proof of the occurrence of a period of general glaciation comparable in its effects with that of eastern North America (see *Quart Journ* Geol Soc vol. xxxiv p. 89, *Canadian Naturalist*, vol viii. No. 7, vol. ix No 1; also the following *Reports* of the Geological Survey of Canada, 1875-76, p 261, 1877-78, p 133 B; 1878-79, p 89 B) In summarising and discussing the evidences of glaciation in British Columbia however Prof Whitney still thinks it necessary to support the correctness of his paper of 1866 As Prof Whitney's volume appears to be intended as a general, and, so far as the facts now known go, final review of the glaciation of the Pacific slope, and professes to contain "all that is necessary to set forth in regard to the former glaciation of the western side of the American continent," it may not be amiss to state that in my view the account given of the evidences of glaciation in British Columbia is in some cases insufficient, and that in the interpretation of other points misconceptions as to the nature of the facts have arisen The tendency of the whole treatment of the subject is to minimise the glacial phenomena of the northern part of the coast and assimilate the conditions there found to those of California, which appear to me to be essentially different (For a comparison of these see "Travelling Notes on the Surface Geology of the West Coast," *Canadian Naturalist*, vol viii. No. 7)

To criticise minutely the numerous features which seem open to such treatment in the account of this region, with which seven seasons' work in connection with the Boundary Commission and Geological Survey of Canada has rendered me familiar, would require a lengthened article, and would at best be an ungracious task I will therefore touch on a few salient points only.

In dealing with the interior region of British Columbia lying between the Rocky and Coast Mountains no mention is made of the actual evidence obtained of a movement of ice from north to south in this plateau district, though it is afterwards incidentally alluded to in a quotation connected with a proposed explanation of the facts observed. The drift covered and erratic strewn character of the country is also ignored; and while the lower terraces bordering the rivers are mentioned, and attributed to fluviatile action—a view doubtless substantially correct—the fact that terraces are found beyond the river-valleys attaching themselves to the higher parts of the plateau and to the mountain-sides to an elevation of 5270 feet is passed over in silence The conclusion is then easily arrived at that the "statement" of 1866 is "entirely borne out by an overwhelming weight of evidence."

Turning now to the coast of the province, Prof Whitney of course admits the marked glaciation of the south-eastern extremity of Vancouver Island, which has been noticed by a number of observers, and which he has himself seen during a hurried visit. He states however that the markings he saw were everywhere parallel to the coast, and appeared to him more like iceberg than glacier work Now as the coast is very sinuous in outline, while the main glaciation pursues *within a few degrees a uniform direction* (S 11° W), the two must in some places coincide, but an intimate acquaintance with the south-eastern part of Vancouver Island enables me to state that the glaciating agent has swept completely and steadily over it entirely, without reference to the present coast outlines With regard to the second statement, I believe that a reference to the description of the character of the glaciation given in one of my papers already referred to (*Quart Journ* Geol Soc. vol. xxxiv. p 92) will be sufficient to convince any one who is familiar with ice action that a glacier has done the work. It is of course easier to be personally assured, where so much depends on judgment of local details, than to demonstrate the actual conditions to others, but the parallel grooving and furrowing out of hard rocks in the manner illustrated on pp 93, 94, and 96, one has been accustomed to consider as characteristic of glaciers

Further on Prof Whitney assumes that the "manifestations" of the supposed Strait of Georgia glacier are "almost or quite exclusively limited to its termination" Some evidence to the contrary is however given in the publication to which special reference has just been made, while subsequent exploration—the published account of which Prof Whitney appears to have overlooked—has brought to light similar and concordant glacier-work at Nanaimo, ninety miles to the north-west of Victoria, and has also demonstrated that a second branch of the great ice mass which choked the space between Vancouver Island and the mainland, comparable in size with that of the Strait of Georgia, discharged north-westward by Queen Charlotte's Sound (*Canadian Naturalist*, vol ix. No 1) In the lately-issued volume of the Geological Survey (1878 79) additional facts tending to show the importance of ice-action in the Queen Charlotte Islands and extreme north of the coast of British Columbia are given

Not being in the position of having any favourite theory of glaciation to maintain, I wish merely to indicate by a few examples the inadequacy of the portion of Prof. Whitney's monograph which is intended to summarise the glacial conditions of British Columbia. Prof. Whitney appears to have been beset by observers "entirely inexperienced in the study of glacial phenomena" to such an extent as to render him unduly suspicious of the evidence obtained by other workers He states, for example, that in passing to the region north of the boundary of the United States "we have to depend largely on the observations of others," and that "an attempt will be made to sift the evidence offered." Now while it is a little discouraging to find that one must belong to the class of "others," I feel confident that to any unprejudiced inquirer the facts already accumulated and published are sufficient to prove the general and pronounced character of the glaciation of British Columbia It is perhaps not too much to ask that in this matter purely negative shall not be put on an equality with positive evidence Prof Whitney's profound distrust of the "others" again appears where he qualifies a reference to my statements by the clause "even if his observations be accepted as entirely trustworthy." It is, however, so far satisfactory to find oneself in good company, for Dr. Hector, who has also had the misfortune to have had something to say about this region which does not conform to Prof. Whitney's hypotheses, is referred to as "evidently quite inexperienced," and one whose "statements must be received with some caution," while Dr. R. Brown for a similar sin is characterised as "an entirely unpractised observer."

GEORGE M DAWSON

Geological Survey of Canada, Montreal, December 22, 1880

Lophiomys Imhausi

IN NATURE of January 1, 1880, I published a note on the "habitat" of that strange and excessively rare rodent *Lophiomys Imhausi*, it may interest many of your readers to know that I have recently received from Count Lodovico Marazzani a splendid specimen of that species from a new locality, viz Erkauid, on the mountains between Suakin and Singat, where it was captured quite accidentally on April 12 last by a shot from a small revolver. It was also secured and preserved by mere chance, for it was found by a small terrier and killed at the bottom of a deep fissure in the granitic rocks, and its value was quite ignored by those who first handled it, thus the skeleton and viscera were lost, but happily the skin was in excellent condition, and the skull had been left attached. It is an adult female and has four teats, two pectoral or rather axillary, and two inguinal, it is rather larger than the fine specimen at Genoa, but does not differ in colour or richness of fur The luxuriant dorsal mane to which this creature owes its name is separated from the long hairs of the body by a narrow stripe of short stiff greyish green bristles The iris was dark brown, and the animal emanated no special odour

This is the *fourth* specimen of *Lophiomys Imhausi* that has been secured to science, the first was the type specimen accidentally brought alive by M. Imhaus at Aden and described by Prof. A. Milne-Edwards it is in the Paris Museum, skin, skeleton, and viscera preserved The second is the skull accidentally picked up by Dr Schweinfurth at Maman, north of Kassala, and described in 1867 by Prof Peters as *Phractomys æthiopicus*, it is I believe at Berlin The third was accidentally killed by a blow on the head with a stick in the Seriba of Beccari and Antinori at Keren in the Bogos country in 1870, the mounted skin and skeleton are in the Civic Museum at Genoa The fourth is the subject of this note, its skin has been splendidly mounted by my able taxidermist Signor R. Magnelli, and it and the cranium form an important item of the Florence Zoological Museum. The natives told Count Marazzani that *Lophiomys* is rare, that it lives in deep holes in the strangely fissured rocks of that country, and that it is a vegetable feeder, the stomach of the specimen I have was much distended with leaves and young shoots when Count Marazzani skinned it

The "habitat" of this species is now pretty well defined by lines drawn from Suakin to Maman and Kassala, and thence southward towards the Somali coast.

HENRY HILLYER GIGLIOLI

Reale Istituto, Florence

Parhelion

YESTERDAY a parhelion or mock sun was seen here. At 3h 20m I was at the Observatory, and the true sun was sinking in the south-west upon a somewhat dense cloud-bank with light and long cirro strati about and above it The air was comparatively calm, the anemometer cups moving only occasionally and slowly The horizon was foggy and misty The spectral sun appeared as a bright diffused circular spot of light tinged with prismatic colours about 30° to the left (E) of the true sun, and in a horizontal line with it.

I could trace a segment of a circle having the sun for its centre, for a few degrees above and below the mock image

To the west I could not trace any false image or continuation of the circle. The phantom image slowly faded away in about ten minutes from its being first observed The weather has been severe here (something over 200 feet above sea), but hardly so sharp as in some other (probably lower-lying) places With Negretti and Zambra's standard minimum in cage four feet from the ground, 11° is the lowest I have registered

During, however, the past seven days the maximum has only twice risen above freezing point, and then but 1°.

Guildown, Guildford, January 21 J. RAND CAPRON

Girton and Newnham Colleges

SOME of your readers may perhaps be glad to help the natural science students of Girton and Newnham Colleges to raise about 800*l*, needed for a physical and biological laboratory. The

present provision for practical work is very inadequate, and the number of students has largely increased, while the required money is not forthcoming. I have already received the following donations, and shall gratefully acknowledge any further help:—Mr Charles Darwin, 5*l*. 5*s*.; Mr Edward Dormer, 5*l*.; Mr T Newland Allen, 3*l*. 3*s*.; Mr William Fasseridge, 2*l*. 2*s*.; Anonymous, 2*l*.; Mr Frank Dethridge, 1*l*. 1*s*.; Anonymous, 1*l*.; Mr. G. Eves, 1*l*.; Mrs Eves, 1*l*.; Mr R. Wilkinson, 1*l*. 1*s*.; Rev C T. Mayo, 1*l*. 1*s*.; smaller subscriptions, 4*l*. 15*s*. Any further particulars will be most willingly given

FLORENCE EVES,
Science Student of Newnham College

Mitton House, Uxbridge, January 22

Minerva Ornaments at Troy *v.* Net-Sinkers

NOT having seen the numbers of NATURE regularly during the autumn, I did not observe Mr Sayce's reply to my letter on the above subject until lately I may perhaps trespass on your space with a few lines in reference to it

I certainly did not observe any markings upon the stones in question that could be construed into any likeness to a human face or to that of an owl. Not having the opportunity of re-examining them I must take this as granted according to Dr. Schliemann's judgment Of course an expert can see, and see with certainty, what to one less experienced seems quite invisible At the same time an enthusiast, as we all know, is rather apt to "oversee," and find in his relics more than actually exists. I say this, as it is a common occurrence, and not in any way to disparage Dr Schliemann's valuable work.

But admitting the existence of such outlines upon the stones in question is it not far more probable that the half savage natives of the Troad may have taken advantage of certain suggestive lines and roughly outlined an image upon a net-sinker, than that they made so large a number of rough and uncouth things as likenesses of Minerva? The use of stones similarly chipped in the middle as net-sinkers seems common to savages all over the world, and it would seem to me therefore wiser to name them net-sinkers (with outlines, &c) than to ticket them "Minerva ornaments"

One point, if I understand him aright, which Dr. Schliemann endeavours to prove, is that Ancient Troy stood close to the river Hence the occurrence of net sinkers may be considered as probable

E. W. CLAYPOLE

Antioch College, Yellow Springs, O, December 18, 1880

THE PROVOST OF TRINITY COLLEGE, DUBLIN

THE Rev Humphrey Lloyd, D D, was born in 1800. He was the eldest son of the Rev Bartholomew Lloyd, who was Provost of Trinity College, Dublin, from 1831 to 1837 Humphrey Lloyd entered his father's college in 1815, graduated as a Gold Medallist in Science in 1820, and was elected a Fellow in 1824 In 1831 he was appointed Professor of Natural Philosophy He was co-opted a Senior Fellow in 1843, was made Vice-Provost in 1862, and was appointed by warrant from the Crown to the Provostship in 1867 He died, after a few days' illness, in the Provost's house on the 16th inst

Full of years and honours, a very distinguished life has been brought to a close Part of it was spent in laborious scientific research, part as the head of a great teaching establishment Both portions of his life were a success, as even a short sketch of that life will show.

Lloyd was an excellent, though by no means a profound, mathematician On becoming the Professor of Natural Philosophy he devoted himself with some ardour to the study of physical optics, and his report on this subject, laid before the fourth meeting of the British Association, was quite a masterpiece of reporting, and may still be consulted with pleasure He was not however by any means content with having a knowledge of the work done by others, but was determined to enter on the field of original work himself, an opportunity soon offered. About 1832 Sir William Hamilton had been investigating the relations between the surface of wave-slowness and that of the wave, and thereby had been led to the discovery of some new geometrical properties of the latter These properties he demonstrated by means of certain transformations of the equations of the wave-surface, and he showed that this surface had four conoidal cusps at the extremities of the lines of single ray-velocity, at each of which the wave is touched not by *two* planes as Fresnel supposed, but by an *infinite* number forming a tangent cone of the second degree; while, at the extremities of the lines of single wave-velocity, there were four circles of plane contact, in every point of each of which the wave-surface is touched by a single plane These singular properties led Hamilton to anticipate two new laws of refraction called by him external and internal "conical refraction" Hamilton was naturally desirous of having his theoretical conclusions proved by experiment, such experiments required a wonderful patience, delicacy of touch, and an almost instinctive sagacity As possessing all these he selected Lloyd to solve his problem, and by his labours in a short time the reality of this interesting phenomenon was established

The memoir by Hamilton and the experimental researches by Lloyd appear in the same volume (xvii) of the *Transactions* of the Royal Irish Academy.

Lloyd published several treatises and memoirs relating to optical science, but he was persuaded by Sir Edward Sabine to turn his attention, about 1836, to the subject of terrestrial magnetism At his request the Board of Trinity College, Dublin, built a magnetical observatory, and the Professor entered with zeal upon those studies of magnetism which will for ever remain connected with his name It would be unnecessary here to enumerate his very numerous writings on this subject

In 1838 the British Association resolved that having regard to the high interest of the simultaneous magnetic observations which have been for some time carried on in Germany and various parts of Europe, and the important results to which these have led, they regard it as highly desirable that similar series of observations should be instituted in various parts of the British Dominions, and they suggested, as localities particularly important, Canada, Ceylon, St Helena, Van Diemen's Land, and the Cape of Good Hope, also in the Southern Hemisphere They further appointed as a Committee to approach the Government on this question Sir J Herschel and Mr Whewell, Dr Peacock and Prof Lloyd The Committee, appointed late in August, at once set about their arduous work, and their memorial was laid before Lord Melbourne in the November following The President and Council of the Royal Society strongly supported the memorial, and these concurrent representations were attended with full effect In the Report of the Committee to the British Association in 1839 it is stated, "probably at the very moment when this report will be read, two ships, the *Erebus* and the *Terror*, under the command of Sir James Clark Ross, will be already on their voyage to the Antarctic Seas, carrying with them every instrument requisite for the complete and effectual prosecution of important magnetical researches in the high southern latitudes, and also complete establishments, both personal and instrumental, of the fixed magnetical observations to be placed at St Helena, the Cape of Good Hope, and Van Diemen's Land It was no wonder that the Committee were proud of the result of their labours, and that they acknowledged in strong terms the ample and liberal manner in which every demand on the national resources had been without exception granted, expressing at the same time the hope that this splendid example might be followed up by other nations The report is signed J F. W Herschel and H Lloyd.

In 1843 Dr Lloyd pointed out a mode of reducing the error attending the determination of the intensity of the earth's magnetic force to less than one-fifth of that by the ordinary method.

In 1858 he again pointed out a fatal imperfection

attending the ordinary mode of calculating the same force, and proposed instead a method requiring for its application only the use of the dip-circle, a vast advantage to the traveller, as it reduced to the smallest possible number the instruments which he would have to carry.

Along with his friend Sabine he visited the chief Continental cities in 1839, going as far as Berlin. This tour was altogether undertaken for the purposes of establishing still further a system of joint records of magnetical phenomena. His chief work in connection with magnetism was published under the title of "The Dublin Magnetical and Meteorological Observations" (2 vols. 4to, 1865-69). In 1857, when the British Association visited Dublin for a second time, Lloyd was then president, and many will still remember his dignified and courteous behaviour as such.

When, in 1867, Dr. Lloyd was appointed provost, there was scarcely one dissentient voice. He had distinguished himself in his college career; his researches had reflected lustre on his university, and the belief in him was never shaken. During his period of office as Senior Fellow the study of the experimental sciences was introduced into the curriculum, in 1851 it was even possible to graduate as a Gold Medallist in these. To the experimental sciences were at first joined the natural sciences. During his provostship, these two groups were separated, to the great encouragement of the students in both. It was something wonderful to find how the now aged provost kept pace with the time, encouraging in every way the more modern view of things. Among the Professors and Fellows of his college he was very popular; he was always affable, while he possessed a quiet dignity. Proudly conscious of the position he held as Provost of Trinity College, he was singularly unambitious of worldly honours, but the honorary degree of D.C.L. from the sister University of Oxford, conferred on him in 1856, was grateful to him, and he always spoke with pleasure of the recognition of his scientific merits by the Emperor of Germany, who conferred on him in 1874 the order "Pour le Mérite;" he was a F.R.S.S. Lond. and Edin. He received the Cunningham gold medal of the Royal Irish Academy in 1862.

GEOLOGISING AT SHEPPEY

SO much has been said about the abundance of fossil fruits at Sheppey that most geologists picture them lying plentifully upon the shore waiting to be picked up, and their only concern might well be at the outset to provide baskets strong and ample enough to convey their collectings home. A day spent upon the beach would dispel these preconceived ideas.

The cliffs in a wet season are streams of liquid mud alternating with freshly-fallen landslips rendering them practically unapproachable. The wet and frost have this year proved exceptionally disastrous, and mere shreds of coast-paths remain. In places slabs of freshly-ploughed land are arrested half-way down the cliff, and at one point a cabbage garden with the produce still only partly cut is streaming down to the beach. It is a good time for the cement works, but when Roman cement falls into disuse, as it seems likely to, then perhaps steps will be taken to stay this perpetual removal of fine arable land into the channels of the Thames. The beach itself is gravelly, and at low water there are extensive mud-flats. Among the gravel are patches of rolled pyrites, and among these pyrites the fruits are found, though valuable specimens are rare. This Christmas five experienced collectors, including Mr. W. H. Shrubsole, F.G.S., Mr. O. A. Shrubsole, F.G.S., Dr. Hausler, F.G.S., myself and brother, searched for several hours without a single fairly perfect fruit being found, and no greater success attended us on subsequent days. The vast bulk of the pyrites is amorphous; the majority of that which retains any recognisable shape is made up of twigs; a considerable percentage is of nearly obliterated casts of shells, and here and there are broken up Nipadites and other water-worn fragments of fruits. The best way to collect is to lie down upon the pyrites and examine it closely, when seeds and twigs that are passed over by the copperas-gatherers may be picked out. In this way I found seeds and scales of Araucaria, twigs of Ephedra, and many other shapes that may some day be recognised as parts of still-existing plants. No rest, short of doing absolutely nothing, could be more perfect to an overworked geologist's brain than to sprawl and smoke upon this beach.

The fruits themselves are so rare in the London Clay that they are seldom if ever found *in situ*, no prolific patches are known, and to attempt to dig for them would be futile. Their abundance in collections is due to the facts that for several miles there are lofty cliffs perpetually wasting away, and that the whole of the clay that reaches the beach is slowly removed in suspension by the sea, every particle of pyrites remaining behind until picked up for copperas or dissolved away. For two hundred years they have been known and searched for daily by the septaria and copperas collectors, and any one may quickly purchase an extensive collection. I have within a few months received from my friend Mr. Shrubsole enough Nipadites to fill a twenty-gallon cask, besides other fruits innumerable. Bowerbank's collection numbers many thousands, 300 specimens of a rare cone alone from Herne Bay having been in his possession. There is in the British Museum a MS. catalogue by a Mr. Crowe of Faversham, with 831 very rough drawings representing, as he supposed, 700 varieties. Ettingshausen, when he examined the British Museum collection, made 200 species. How many there may really be is still unknown, but the number doubtless is very considerably beyond the latter. Among the Coniferæ alone I have to add, besides the Ephedra, a *Podocarpus* near to *P. elata*, a *Frenella* almost indistinguishable from *F. Endlicheri*, and an *Araucaria* near *A. Cunninghami*. I have grave doubts about the correctness of the determination of all the other Coniferæ except a few of Bowerbank's Cupressineæ, and am still at work upon them. The state in which they are preserved is not sufficiently taken into account. The woody matter is generally preserved as lignite, and easily removed when rolled upon the beach, and the pyrites which remains filled the cavities between the more solid parts, as well as replacing the fruit itself. The densest and most salient part now is the purest pyrites, and was therefore at the time of fossilisation probably the most open part of the fruit or the filling in of cavities. The casts that are found are thus, in the case of hard-shelled fruits, more often casts of the space between the outer ligneous shell and the kernel, than of either the kernel or the shell itself. In the case, for instance, of an almond, we should have most frequently a smooth cast of the inside of the shell, but in perfect fruits the pitted exterior would be preserved, and in fruits partially dissolved the wrinkled kernel would show. In fruits with septa the variety of aspect presented in different stages of preservation is very great, and has doubtless led to the same species being catalogued under several names. The so-called Sequoia or Petrophiloides of Herne Bay is another instance, for the filling in between the open scales of the cone was thought by Bowerbank to represent confluent scales inclosing cells, the supposed cells being really the cavities left by the true scales which have decayed away, while the infiltrated pyrites has enveloped the seeds which lay under them.

On Monday we took the 8 a.m. train to Herne Bay and searched at Studlecliffe for cones. At Whitstable we set sail in an oyster boat for Shellness, but some delay occurred in getting it off the ground; the wind dropped in the meantime, and we had to row. Shellness

was reached at dusk, and we experienced some difficulty in landing across the mud, which stretches a long way from shore at low water. We reached Warden Point at 6, and found that the fly we expected to meet us had driven home an hour before. The position of two mud-covered and complete strangers on a dark night on a most desolate spot, in drenching rain, eight miles from, and two hours late for dinner was not particularly enviable; yet a well-arranged excursion from Whitstable to Sheerness, *viâ* the singular shores of Shellness, would under pleasanter circumstances well repay any naturalist.

J. STARKIE GARDNER

THE CONSERVATOIRE DES ARTS ET MÉTIERS[1]

ONE of the most eminent English men of science said to us one day —"You have at Paris collections, libraries, museums, observatories, faculties, schools, we have the equivalent of all that There is only one thing we have not, which I always admire among you, and that is the Conservatoire des Arts et Métiers"

The National Conservatoire des Arts et Métiers[2] is, in fact, an establishment unique of its kind both in its scientific interest and practical utility. No institution is more

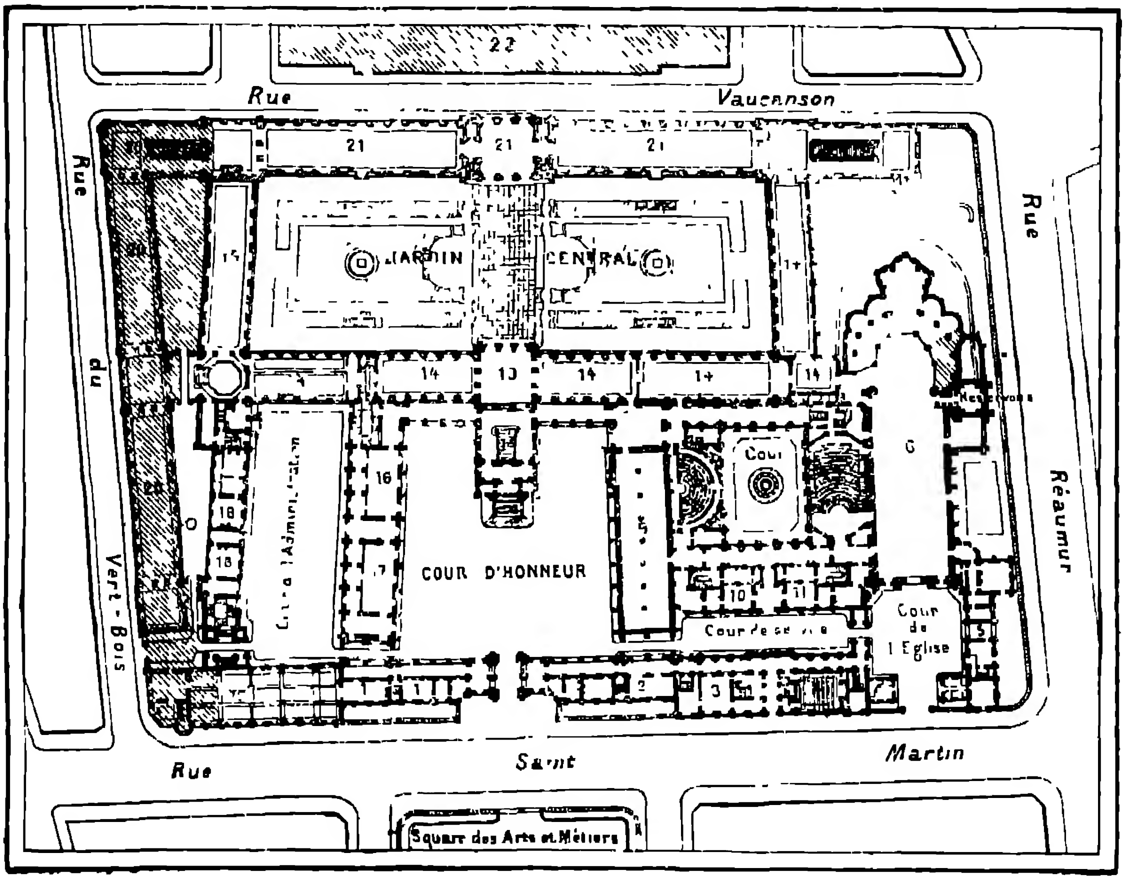


FIG. 1 —Plan of the Conservatoire des Arts et Métiers, and of projected additions —1, Office for the verification of weights and measures, 2, Laboratory of the Course of Mechanics (Prof Tresca) 3, Ground-floor Laboratory of the Course of Dyeing and of Ceramics (Prof Luyre), First floor Laboratory of Agricultural Chemistry (Prof Boussingault), 4, Ground floor Amphitheatre, First Floor Physical Laboratory (Prof Becquerel), 5, Provisional location of the Agronomic Institute, 6, Great Hall of Machinery in motion, 7, Great Amphitheatre; 8, Old Amphitheatre, 9, Library, 10, Laboratory of Industrial Chemistry (Prof. Girard) 11, Laboratory of General Chemistry (Prof Peligot), 12 Great staircase, 13, The Echo Hall 14, Galleries and Collections, 15, Ground-floor Gallery in construction, First floor Gallery of Ceramics and Optics, 16, Ground floor Weights and measures First floor Gallery of Spinning, 17, Exhibition Hall and Gallery of Spinning, 18, Administration and Gallery in construction, 19, Industrial drawings, patents, and trade-marks, 20, Projected construction, gallery of collections, 21, Projected construction, 22, Proposed location for the Central School of Arts and Manufactures

worthy of the solicitude of the Government, since it has for its object the occupation of the workers and the instruction of the people The Conservatoire is about to make a fresh start in consequence of the construction of a new block of buildings There is even reason to hope that these works will only be the prelude of constructions still more important, and that very soon a law will insure the completion of our fine national establishment. The following are some of the improvements which have been recently introduced into the institution.

The service of patents and of the industrial department has been recently installed in the new buildings in the rue St. Martin. Early in November there was placed at the service of the public the old and remarkable collection of Vaucanson's drawings. These drawings, which form a considerable series, comprised between the years 1775 and 1829, have a great historical interest We find in them the germ of a considerable number of apparatus or of systems realised in our time, and which the want of processes of execution condemned to remain in the condition of projects We see there a great number of curious objects, and notably the original drawing of Fulton's first steamer

Among recent additions we may mention the great gallery of machinery (No. 6 in the accompanying plan, Fig. 1), to which is added the entire apse of the old

[1] From an article in *La Nature*, by M Gaston Tissandier

[2] Descartes had the idea of its foundation, Vaucanson formed the first germ of it by his public collection of machines, instruments and utensils, intended for the working classes and the Convention decided on its definitive creation by a decree of 8 vendémiaire of the year XII

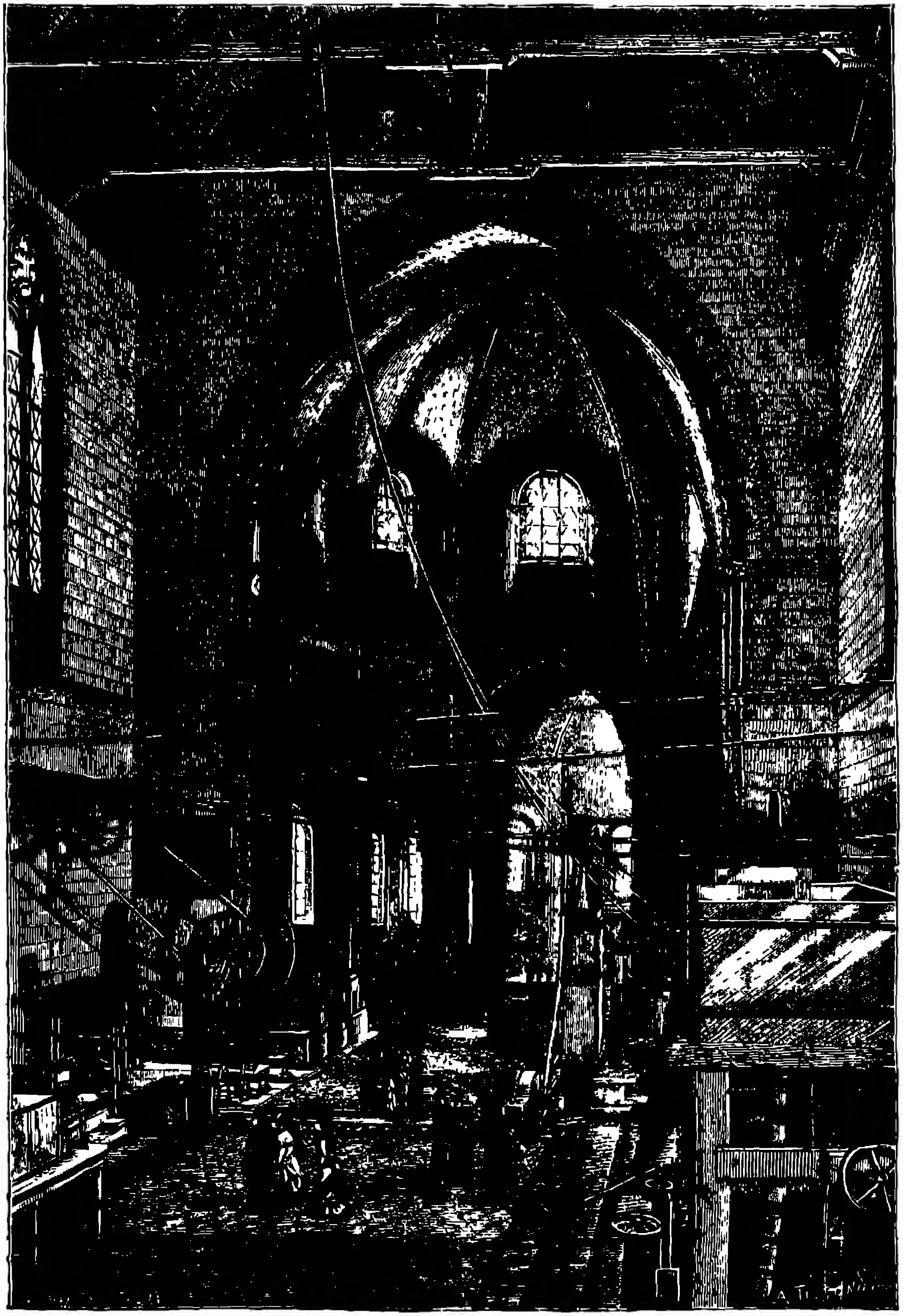


FIG. 2 —The Great Machinery Hall of the Conservato

church of St. Martin's priory We see here the curious steam-carriage of the mechanician Cugnot, and the fine statue of Denis Papin by M Aimé Millot, the bronze duplicate of which was inaugurated at Blois some weeks ago. Besides the machinery which has long been at work in this gallery, the new administration of the Conservatoire is endeavouring to show visitors all the new and interesting apparatus used in the great Parisian industries More than 3000 visitors witness every Sunday these experiments, very beautiful and very instructive for every one. Among the most notable apparatus are those connected with electrical phenomena The beautiful experiments of M Gaston Planté have obtained the greatest success, as also those relating to the transmission of power to a distance by electricity The Conservatoire is thus becoming the museum of machinery in action

While the machinery is thus at work in the great nave, other experiments are going on in the galleries. The great electrical machine throws off sparks in the physical hall, and projections by means of the oxyhydrogen light are made elsewhere by M Molteni Visitors show great interest in the Echo room, the Lavoisier room, in which is a great number of instruments used by the founder of modern chemistry, the Agricultural room, where are exhibited all the newest models of agricultural machinery It is scarcely necessary to speak of the courses of lectures by eminent professors, many of whom are known beyond France, the gratuitous courses here and at the Sorbonne for 1880-81 comprise almost every branch of pure and applied science The public library of more than 30,000 special works is freely placed at the disposal of workers.

Among the less known departments is the public service for testing the resistance of materials, very useful to architects, contractors, and builders Any one may take advantage of it It is sufficient to send to the Conservatoire specimens of stone, marble, pottery, metals, tubes, &c, which are crushed, broken, or bruised by special machinery, and the results accurately registered. The most powerful of these machines is a hydraulic press of 500,000 kilograms.

Such, in few words, is the Conservatoire des Arts et Métiers. By its collections, its public courses, its library, its eminently practical services, it may be regarded as one of the most valuable institutions of France

NOTES

THE Faraday lecture will be delivered by Prof Helmholtz in the theatre of the Royal Institution on Tuesday, April 5 The subject will be "The Modern Development of Faraday's Conception of Electricity" The lecture will be delivered in English.

PROF. HOLDEN, of the U.S Naval Observatory, Washington, has published, through Scribner, a biography of Sir William Herschel Prof Holden is also publishing, through the Smithsonian Institute, a subject index and synopsis of the scientific writings of the great astronomer.

THE Kent's Cavern Committee, when presenting their *final* Report in August last to the British Association stated that, from the first day of the exploration in 1865 to its close in 1880, George Smerdon had been continually engaged on the work, and for nearly thirteen years had been the foreman; that during that period he had always discharged his duties in a most exemplary manner, and without the least misunderstanding with the superintendents; that he was nearly sixty years of age, and so crippled with chronic rheumatism—induced by working for so many years in the damp Cavern—as to be incapable of any ordinary labour, and that it was proposed to raise by subscription a fund sufficient to secure him a small annuity The proposal was cordially received, and Mr. Pengelly was encouraged to carry it into effect. Several contributions have already been received from Mr. G. Busk, Prof. W. B. Dawkins, Dr John Evans, Mr. J. E. Lee, Sir John Lubbock, Bart., M P, F.R.S., Mr W Pengelly, Mr. E. Vivian, M.A., and others Further contributions to the "Smerdon Testimonial Fund" may be paid directly to Mr. W. Pengelly, Lamorna, Torquay, or to Messrs. Vivian, Kitson, and Co, Bankers, Torquay

A MARBLE statue of Nicephore Nièpce, the inventor of photography, is now being executed by the celebrated sculptor, M. Guillaume of Paris, and will be erected and unveiled in May next at Châlons-sur-Saône.

PROF. MASKA of Neutitschein writes that the excavations now going on in the Schipka Cave, near Stramberg (Moravia), have yielded some interesting results Among the numerous remains of Post Tertiary animals (such as mammoth, rhinoceros, urochs, horse, lion, hyæna) the jaw-bone of a supposed diluvial human being has been found. It was imbedded in the immediate vicinity of a place where carbonised animal bones, stone implements, and bone utensils were found. The jaw-bone, described as having belonged to a child of some eight years of age (according to the development of the teeth), is of very large, indeed of colossal dimensions

THE director of French Lighthouses has sent to the Minister of Public Works a communication recommending the lighting, by electricity, of all the great lighthouses on the French coasts. It will involve an expenditure of several millions of francs, which will end in a large economy and an extension of the range of illumination A system of steam-trumpets is also to be established in connection with these improved lighthouses.

WITH the January number the *Quarterly Journal of Microscopical Science* enters on the twenty first volume of its second series. First published in 1853, under the editorship of Dr Edwin Lankester and Mr. George Busk, it now appears under the editorship of Prof. E Ray Lankester, assisted by Mr F M Balfour, Mr W. T. Thiselton Dyer, and Dr E. Klein. Mr. William Archer has withdrawn from the editorial staff.

THE minutes of the *Proceedings* of the Dublin Microscopical Club, which since 1865 have been published in the *Quarterly Magazine of Microscopical Science*, will for the future, we understand, be published in the *Annals and Magazine of Natural History*.

WE understand that Mr. Richard Anderson, the author of the well known work on Lightning Conductors, has nearly ready for publication a treatise—based on the "Instruction sur les Paratonnerres adoptée par l'Académie des Sciences" of France—to be entitled "Information about Lightning Conductors."

AT its last session the French Parliament voted a grant of several millions of francs for the completion of an underground system of telegraphic wires connecting the principal cities with Paris

SEVERAL electric railways are to be tried on the occasion of the forthcoming Electrical Exhibition at Paris. The most important will be built by Siemens Brothers, and will form consequently a prominent part of the British display. At the last sitting of the General Council of the Exhibition M. Georges Berger announced that a steam-engine of 800 horse-power will be arranged for the working of the electric light, and the number of lamps in operation is estimated at 600. A number of these will be in the large hall, but a large proportion in the gardens, in the *annexe*, and in a series of saloons fitted up magnificently with tapestry-work by the Government The *annexe* is to be the Pavillon de la Ville de Paris, which was one of the wonders of the 1878 Exhibition, and will be transported to the vicinity of the Palais de Champs Elysées.

IN connection with our recent note on the Young Men's Home Education Society, a lady in Cork sends us some information concerning the Minerva Club, whose head-quarters seem to be in that city, and which aims at enabling ladies to educate themselves at home. The regulations of the Club seem well adapted for this purpose, and the programme includes natural science. The books recommended are all standard ones, and the examiners men of good standing in literature and science. The specimens of the examination papers sent us in geology and geography show that a high standard is aimed at. The honorary secretary of the Club is Mrs. W. S. Green, The Rectory, Carrigaline, Co. Cork.

IN the course of dredging operations in the bed of the Limmat, at Zurich, some very interesting objects have been brought to light, among others ancient coins (including fifty gold pieces of Brabant), swords, and the skeleton of a stag of a species now extinct in Switzerland. The piers of a Roman bridge which once spanned the river have also been laid bare. All the finds are being placed in the Zurich Historical Museum.

A REPORT has reached Vienna, January 24, which has not yet been confirmed, of a fresh earthquake at Agram, attended with disastrous consequences. At Landeck (Tyrol) three shocks were noticed on January 10, at 9 p.m. The first one was the most violent, and the other two followed at intervals of five minutes. The earthquake which was felt at 5.15 p.m. on December 25, in Southern Russia, extended as far as Odessa and Kishineff in south-west, Tiraspol, Byeltzy, in Bessarabia, and the Ouman district of the province of Kieff in north east; it was strong enough in the villages Teghezino and Vishnepolie of this district. At Molokishi, district of Balta, and at Byetzy, it was very strong.

A METEORIC stone fell at Wiener Neustadt a few days ago, near the telegraph office, and penetrated deeply into the gravel-covered road. The phenomenon was witnessed by several persons, who all declare that the meteor showed a brilliant light. Upon inspection a triangular hole was discovered of 5 centimetres width, the ground was frozen at the time. The meteoric stone was excavated in the presence of Dr. Schober, director of the Wiener Neustadt High School. It weighs 375 grammes, is triangular in shape, its exterior is crystalline, with curious blackish, greyish, and yellow reddish patches. Here and there metallic parts give a brilliant lustre. Its specific weight is very high, its hardness about 9. An analysis is now being made.

THE second series of Evening Lectures delivered at the Royal College of Science, Dublin, has commenced with satisfactory entries. The classes have been voluntarily undertaken by the professors in order to afford a systematic course of study available to beginners and to those who are earning their livelihood in various avocations during the day. Artisans and others receiving weekly wages are admitted at half fees. The courses consist of from fifteen to twenty lectures in each of the following subjects: Biology, Dr. McNab; Physical Geography, Prof. O'Reilly; Geology and Mineralogy, Profs. Hull and O'Reilly; Chemistry, Prof. Hartley; Physics, Prof. Barrett; and Mathematics, Mr. Stewart, the Demonstrator in Physics. During the session of 1879-80 the numbers in attendance at the various classes were 336. In order to give assistance needful for the continuance of this course of instruction the Worshipful Company of Drapers have generously voted the sum of 100*l*. per annum for a period of three years. The earnestness, intelligence, and regularity of those attending the evening classes is remarkable, giving evidence of a hearty desire for sound and solid scientific instruction in Ireland, as well for the love of knowledge itself as for the purposes of technical information.

NEWS from Cairo states that to the north of Memphis, near Saggarah, two pyramids have been discovered which were constructed by kings of the sixth dynasty, and the rooms and passages of which are covered with thousands of inscriptions. The discovery is said to be of the greatest scientific importance.

THE Prefect of the Seine has opened in Paris a public laboratory for the analysis of any substance used for food; the fees are very moderate, and vary from 5 francs to 20 francs, according to the difficulty in the determinations.

A MEDICAL gymnasium was opened on January 22 at Paris. It has been built in the Chaussée d'Antin at an expense of 20,000*l*., by a public company. About seventy mechanical contrivances of different descriptions have been arranged in a series of rooms. The greater number of these are worked by a steam engine, and all of them can be graduated by screws, so that the extent, duration, and velocity of motion can be regulated according to the direction of the physicians.

THE electric steamer *Pouyer-Quertier*, belonging to MM. Siemens Brothers, has arrived at Havre, after having successfully repaired the French cable, which had been discovered to be faulty.

IN his last report to the Foreign Office H.M.'s Consul at Shanghai points out that the Chinese are much more disposed to allow the opening of coal mines than the construction of railways. Without referring to the work being done in Formosa, he mentions that operations are in progress under English engineers for the opening of coal-pits at Kaiping, near Tientsin, and near Nganking, the capital of the Nganhwuy province. Both districts have plenty of coal, but unfortunately no navigable waterway, and for this reason the engineer of the Nganking coal-mines intends to remove to another locality near by, where there is an equal quantity of coal and better water-power. At Kaiping matters are worse, for the nearest navigable stream is at Lutai, forty miles away. To reach this it is expected that a railway may be constructed, but, as it can hardly be a commercial success, it would not much promote the cause of railway enterprise in general. The engineers find no difficulty at Kaiping in obtaining Chinese labour, but the English workmen sent there have not given satisfaction, and the Chinese are getting rid of them.

M. MAGITOT, a member of the Prehistoric Congress which met at Lisbon last autumn, reports on a Portuguese Pompeii, which he had occasion to inspect while on a tour to the territory of Tertiary Silex at Otta. The place is called Santarem and Citania. The latter is the general Portuguese name for ruins of ancient towns, which cover entire hills in the neighbourhood of Braga. The most important of these very old town ruins is the Citania di Briteiros, which occupies nearly a kilometre square, and is supposed to be of Celtic origin. Circular walls, streets, squares, large architectural monuments, and even a number of houses have retained their typical forms. For twenty centuries this Citania was buried below *débris*, soil, and a rich vegetation; only a few years ago a zealous archæologist, Senhor Sarmento, succeeded, by costly and troublesome efforts, in clearing away the covering of centuries and to lay open to the world an ancient city in which quite a primitive state of civilisation is apparent. Its architecture and plastic ornamentation point to a somewhat advanced state of art and industry. Many stone monuments are covered with sculptures and inscriptions, which in their general character recall those of India and China, which the well-known Lyons archæologist, M. Guimet, declares to be of a symbolic and religious character, similar to those found upon the oriental monuments. It is possible that this fact might be adduced as a proof that the tribes who built these Citanias had originally emigrated from Turan.

NEWS from Washington territory states that the volcano Mount Baker was in full eruption quite recently.

We have received the first number of the *Revista* of the Society of Instruction of Oporto. There are various papers bearing on education, and one by Mr E J Johnston on the Phanerogamous Flora of Oporto The number of English names on the list of this Society is remarkable, the first name among the Foundation Members is that of Isaac Newton, followed by W. C. and A. W Tait, there are several Allens, a Johnston, several Kendalls and Coverleys, F. C Rawes, Henrique Rumsey, a Grant, a Hastings, and an Archer This no doubt indicates the close commercial relations between Oporto and England

It is known that Leverrier, urged by growing infirmities and apprehending that he would not live to accomplish his great work on the theory of Saturn, left a part of his calculations uncompleted, convinced that this would exert no real influence on the total result But M. Gaillot, the director of the Calculation Service of the Paris Observatory, felt it a duty to fill up the gap left by the late director of the observatory and to revise the whole of his work. We are happy to state that, as far as the revision has gone, the accuracy of the conclusions published by the great astronomer is demonstrated, and none of the neglected terms will exert any appreciable influence

We take the following from the *Albury Banner* (New South Wales):—It has long been a matter of popular belief that the great kingfisher was an enemy of the snake, perpetually warring upon the tribe in general, and never happier than when dining on serpent *au naturel* It is not often, however, that even persons habitually residing in the bush have so good an opportunity as that afforded a few days since to Mr Christian Westendorff of Jindera, for observing the laughing jackass when in the act of bagging the game referred to. Mr Westendorff was engaged with another man in clearing some land, and in the course of the day's operations it became necessary to shift a large log For this purpose levers were applied to each end, and after some straining the log was rolled from its resting-place The very moment it commenced to move a laughing jackass, which had hitherto been taking a deep but unobtrusive interest in the proceedings, made a swoop down from the limb of an adjacent tree, and seized a large snake which had been lying under the log. The snake was gripped by the back of the neck (if snakes can be said to have necks) and borne away to the bird's previous perch, where the unfortunate reptile was banged against the bough until the body separated from the head and fell to the ground. The jackass then dropped the head, and seizing the body sailed away in triumph with his prize. Whether the bird had seen the snake go under the log and was watching for it to come forth again, or whether it knew by instinct that the reptile was there, is a question that may be left for naturalists to determine; but we are credibly informed that as soon as the log was shifted, and before Mr. Westendorff or his companion had any idea of a snake being in their neighbourhood, the jackass was down and had made good his seizure.

The Russian Technical Society has created a special branch which will devote its attention to aeronautics, especially to the popularisation of all branches of aeronautics, to recent researches on this field, to the meteorology of the higher regions of the atmosphere, and to the study of the applications of aerostatics to military purposes.

We note from the *Deutsche Industrie-Zeitung* that during 1879 some 140 tons of amber were obtained at the coast of the Baltic, of which the mine at Palmnicken yielded seventy-five tons, and the digging-engine at Schwarzort the remainder. About fifteen tons were gathered by nets and picked up on the shore. Some 3000 people (including women and children) gain their living by gathering amber.

At the end of 1880 the Berlin Electro-technical Union numbered no less than 1575 members, 1246 of whom are foreigners.

A number of Celtic tombs were recently discovered near Lichtenwald, on the frontier between Styria and Carniola, not far from Cilli. Several of them were opened, and numerous urns were found in them. A few objects of more interest have been sent to the local museum at Cilli.

The well-known Hungarian archæologist, Herr Wilhelm Lipp, continues the excavations of the ancient burial ground discovered by him at Keszthely The cost is borne by the Budapest Archæological Society. These tombs are rich in bronze and iron objects dating from the fourth and fifth centuries

OUR ASTRONOMICAL COLUMN

Brorsen's Comet in 1842.—In September, 1846, it was pointed out by Mr Hind (*Astron Nach* No 582) that the comet of short-period discovered by Brorsen at Kiel on February 26 preceding must have approached very near to the planet Jupiter about May 20, 1842, possibly within 0 05 of the earth's mean distance, and it was surmised that an entire change of orbit might have been produced at that time In 1857 D'Arrest examined this point more closely, applying the formulæ of the *Mécanique Céleste* to determine the elements prior to the encounter with the planet His results were published in *Astron. Nach* No. 1087 Adopting good elements for 1846, but without taking account of perturbations, since the comet left the sphere of activity of Jupiter after the near approach, he inferred that the closest proximity occurred May 20 6924 Berlin mean time, the distance between the two bodies being then 0 05112; that for April 19·5 the inclination of the comet's orbit was 40° 51′, or 10° greater than in 1846, and that the perihelion distance was greater than 1 5, instead of 0 65 at the time of Brorsen's discovery, and it was considered that the comet would not be visible when the radius-vector was much over unity, hence, perhaps, our ignorance of its existence before the year 1846 Thus the question has remained until within the last two years. Our object now is to record the results of a much more complete investigation of the effect of the comet's encounter with Jupiter, by Herr Harzer, forming the subject of an inaugural dissertation in the University of Leipsic in 1878 He adopts the definitive elements of Prof. Bruhns for 1846, with a small correction to the mean motion indicated by the observations at the comet's reappearance in 1868, and calculates backward with great care the perturbations of Mercury, Venus, the Earth, Mars, Jupiter, and Saturn to 1842, July 16 5, when the distance from Jupiter was 0 305, the total perturbations in the interval 1846, February 25·5—1842, July 16 5 are as follows—Mean anomaly, − 1° 58′ 32″ 6, mean sidereal motion, + 4″ 391, longitude of perihelion, + 9′ 52″ 8; ascending node, + 24′ 35″ 4, inclination, + 1° 48′ 31″ 4, angle of eccentricity, + 56′ 30″ 0. From the ecliptical co ordinates of the comet with respect to Jupiter at the latter date and the variations of these relative co ordinates, the hyperbolic elements of the orbit about the planet are obtained and the perijove is found to have taken place May 27 28488 M T. at Berlin, when the distance was 0·054714 The hyperbolic elements are assumed to 1842, April 7·5, when the distance between comet and planet was 0 30334, and the radius of the sphere of attraction 0 27149 The elements are then again referred to the sun, and thus the following figures defining the comet's orbit before this near approach to Jupiter, result.—

Epoch, 1842, April 7 5 Berlin M.T

	° ′ ″	
Mean anomaly .	135 0 58 0	
Longitude of perihelion ..	111 50 20 6	1846·0
" " ascending node .	103 42 12·8	1846·0
Inclination .	46 18 57 4	1846·0
Angle of eccentricity	49 32 10·0	
Mean daily motion . . .	686″·253	
Log. semi axis major	0·4756809	
Perihelion distance .	0 7151810	

The only very striking difference from D'Arrest's figures, which were confessedly a rough approximation, is in the perihelion

distance, which, as will be seen, is found to be much smaller, indeed not one-half as great, by Herr Harzer.

The author of this very able dissertation remarks upon the similarity of the elements he has deduced for Brorsen's comet before the near approach to Jupiter, to those of the first comet of 1798, discovered by Messier on April 12 and observed by him till May 24, this comet was computed by Burckhardt and Olbers. Herr Harzer finds, however, that it is not probable Messier's observations will admit of an orbit widely different from a parabola. He considers there is reason to conclude that the orbit of 1842 was impressed upon the comet by a close approach to Jupiter in 1759-60, and that another change may be similarly produced in 1937, as hinted by D'Arrest.

HERSCHEL'S FIRST OBSERVATION OF URANUS.—We are now close upon the centenary of the discovery of Uranus on March 13, 1781. Perhaps some readers may be interested in the following examination of the first evening's measures of distance and angle of position from a small star, with which Herschel compared the planet till March 21. In his "Account of a Comet," for as such the planet was announced in a communication to the Royal Society read on April 26, he gives the distance from the small star "2′ 48″ by pretty exact estimation true to 20″," and the angle "0° 0′ by superficial estimation, liable to an error of 10° or 12°," this angle corresponding in our present system of double-star measures to 270°, or preceding on the parallel this distance and angle are for 10h. 30m at Bath.

By Prof. Newcomb's pretty accurate "provisional theory," we find the place of Uranus for 1781, March 13, at 10h 30m M.T. at Bath, or 10h 39m 20s Greenwich M.T., to be as follows:—True R.A. 5h. 35m 47·77s, true Decl. +23° 32′ 58″·3, and the corrections to apparent place are −0·32s and −0″·2, the log distance of the planet from the earth being 1·27742. It is clear from this that Herschel's star, which he calls *a*, is No. 1576 in Rümker's Catalogue (the first impression of ob.—6h.), where it is estimated a tenth magnitude. Argelander in the *Durchmusterung* has 9·0. The mean place accurately carried back to 1781·0 was—

R.A. 5h 36m 0·85s. Decl. + 23° 32′ 3″·7.

For this date and hour we find, in the notation of the *Nautical Almanac*—

Log A −1·2709 Log B +0·3473. Log C +7·7110.
Log D −0·8971.

Whence the apparent place of the star was—

R.A. 5h. 36m. 0·84s. Decl. + 23° 32′ 11″·6.

Consequently the calculated distance of planet from star is 3′ 10″·2, and the angle of position 284°·2, agreeing as nearly with Herschel's estimates as under the circumstances can be expected. At his next observation on March 17 the distance by observation was 42″, the computed distance 54″.

GEOGRAPHICAL NOTES

THE last meeting of the Russian Geographical Society was very animated, owing to the presence of Prof. Nordenskjold. The great hall of the Society was crowded, and the explorer of the northern seas was greeted with loud cheers. The president of the Society, M. Semenoff, opened the meeting with a speech of welcome in which he sketched the long series of expeditions undertaken from Europe to Siberia since the year 1553, when Willoughby directed his three ships to the White Sea, and paid for his undertaking with his life. Prof. Nordenskjold replied in a short speech, referring to the expeditions which will start next spring for the exploration of the Siberian shores, and Prof. Lentz made a communication on Polar meteorological stations and on their importance for science.

ORENBURG was the first town which enjoyed the pleasure of hearing the story of Col. Prjevalsky's journey told by himself. On his passage through this town, on January 2, the traveller gave a lecture on the adventures of his journey to Tibet, which we have already told. From Orenburg M. Prjevalsky started to visit his relations at Smolensk, whence he proceeded to St. Petersburg, reaching it at the same time as his companions and his collections, which were at the beginning of January on their way from Orsk to Orenburg.

DR. LENZ, the German traveller who lately accomplished the feat of reaching Timbuctoo from the north, has arrived at Bordeaux, and is expected at Berlin soon to give an account of his explorations.

THERE are at present sixty-five geographical Societies in the world. The oldest of these is that of Paris, founded 1821; there is also a Society of Commercial Geography at Paris, founded 1873. Besides these France has geographical societies at Lyons, Bordeaux, Marseilles, Montpellier, Rouen, Nancy, Bergerac, Périgueux, Rochefort, Mont-de-Marsan, Agen, Apinal, Rochelle, Douai, Dunkirk, St. Omer, Lille, and one is about to be founded at Bar-le-Duc. The Berlin Geographical Society was founded in 1828, besides which Germany has similar societies at Frankfort, Darmstadt, Leipsic, Dresden, Munich, Bremen, Halle, Hamburg, Friberg, Metz, Hanover, other societies are in formation at Halberstadt, Magdeburg, and Jena. The London Geographical Society, the only one in England, was founded in 1830. The next oldest society (after Frankfort) is that of Rio Janeiro, founded 1838, then Mexico, 1839; St. Petersburg, 1845, in Russia there are besides—societies at Tiflis, Irkutsk, Vilna, Orenburg, Omsk. The other societies are those of the Hague, 1851, New York, 1852, Vienna, 1856, Geneva, 1858, Rome, 1867, Buda Pesth, 1872, Amsterdam, 1873, Bucharest, 1875, Lisbon, 1875, Madrid, Antwerp, Brussels, Copenhagen, Lima, all 1876, Stockholm and Quebec, 1877, St. Gall, Berne, Oran, 1878, Tokio, 1879, Buenos Ayres, Algiers, and Oporto, 1880.

THE Hamburg firm of C. Woermann has sent Mr. Hermann Soyaux to the French colony of Gaboon in order to try to cultivate the coffee-tree of Liberia at that place. Soyaux has now been at Gaboon for two years, and has there established the Sibonge farm, which is situated about a day's march inland from the Gaboon River, on the Awandu River, which flows in a north-easterly direction into the Bay of Corisco. He now employs some 100 negroes. Many thousand coffee-trees have been imported from Liberia, and have been planted, and experiments have also been made with sowing the beans, so that at the beginning of 1882 the first coffee-harvest is confidently expected. The Hamburg firm supports the undertaking in a most efficient manner by sending engines, implements, &c., and experiments are also pending to introduce and acclimatise horses and mules. Mr. Soyaux makes meteorological observations for the Leipsic Observatory and natural history collections for the Hamburg Museum.

IN the current number of *Les Missions Catholiques* we find appended to a letter from Mgr. Cluzel, the Apostolic Delegate in Persia, some notes on the Kurds, which are just now of considerable interest. These notes deal with the origin of the Kurds, their country, language, present condition, religion, manners and customs, &c.

THOUGH no doubt much geographical information respecting the Philippines may be obtained from Spanish works, there is but little readily accessible to the English reader. It may therefore be well to call attention to a useful *résumé* furnished by H.M.'s Consul at Manila in his commercial report for 1879. He gives some brief particulars respecting each of the twenty-one provinces into which the principal Island of Luzon is divided, and afterwards deals with some of the other chief islands. The interior of the Island of Mindoro, immediately south of Luzon, he tells us, is not explored, but is supposed to contain much mineral wealth. In the Visayan group much of the interior of Negros, Samar, and Paragua is likewise not explored. Capt. Pauli adds that the archipelago is believed to contain 1200 islands of all sizes. The report is accompanied by an outline map, on which the principal islands are shown, as well as the division of Luzon into provinces.

M. LUCEREAU, a member of the Paris Geographical Society, has been killed by natives on his exploring expedition in Eastern Africa. He had started from Aden in June last in order to reach the Upper Nile by crossing the territory inhabited by the Gallas Negroes.

THE *Bulletin* of the International Geographical Institute at Berne has with the new year begun a new series on a larger scale than the previous issue. In the first number the contents of previous issues are resumed, the chief novelty being a fine map of the South Polar regions, on linen, in connection with the proposed Italian expedition. We cannot yet see exactly what place this *Bulletin* fills in geographical journalism.

DEEP-SEA EXPLORATION[1]

THIS subject is one in which I have for many years taken much interest, and I will give you the result of my experience and studies. It is highly fascinating to all persons of ordinary intelligence, although they may not be naturalists. Our best poets have not disdained to sing its praises; one of them says,

> "There is a magnet-like attraction in
> These waters to the imaginative power
> That links the viewless with the visible,
> And pictures things unseen"

Speculations of this kind were not unknown to the ancients. In the "Haleutica" of Oppian, written nearly seventeen centuries ago, it is stated that no one had found the bottom of the sea, and that the greatest depth ascertained by man was 300 fathoms, where Amphitrite had been seen. But this grand discovery does not seem to have satisfied the poetical philosopher; and he enters into a long disquisition as to the many other wonderful things that may be concealed in the recesses of the boundless ocean, adding, nevertheless, what I will translate from the Greek:—

> "But men have little sense and strength."

However, man has not degenerated in this kind of knowledge since the days of Oppian, for he has now not only explored the greatest depths of the sea, but has mapped out its main features with nearly as much accuracy as he has done with respect to the land.

It will be more convenient to divide the subject into separate heads, viz —(1) Historical, (2) Apparatus, (3) Fauna, (4) Food, (5) Light, (6) Temperature, (7) Depth, (8) Inequalities of the Sea-bottom, (9) Deposits, (10) Geological, (11) Incidental, (12) Concluding Remarks

I hope you will not be frightened at the number of these heads. Some of them you will find to be exceedingly short.

1 *Historical.*—Sir Wyville Thomson's "Depths of the Sea" gives an excellent account of the origin and progress of deep sea exploration up to a very recent period To this work I would refer my audience, contenting myself with some supplemental remarks

In 1868 commenced the systematic examination of the sea-bed at considerable depths in that part of the North Atlantic which surrounds the British Isles. I then took my yacht, the *Osprey*, for another excursion to Shetland, and dredged off the most northern point of our isles The greatest depth which I attained was 170 fathoms, or 1020 feet, each fathom being 6 feet This depth, strictly speaking, is beyond the line of soundings, viz 100 fathoms · and it may be a question whether the fauna of the sea-bed outside of that limit can be regarded as British, although adjacent to our coasts. If it be we ought to take the "medium filum aquæ" (as the lawyers in the time of Coke called it), and extend the geographical limit of the British marine fauna half way across to North America! But such boundaries are neither national nor rational We cannot lay claim to so extensive a dominion International boundaries, for the purpose of naval warfare or as defined by fishery treaties, are limited to a distance of three miles, irrespective of depth Later in the same year (1868) Dr. Carpenter and Prof Wyville Thomson explored, in H.M surveying-vessel *Lightning*, the sea bed lying between the Butt of Lewis and the Faroe Isles, and reached the depth of 550 fathoms These tentative excursions showed that the sea-bed everywhere was full of life, not merely of a microscopic and uniform kind, and of a low degree of organisation, but of a considerable size, great variety, and a high degree of organisation. In the following year (1869) our Government placed a better vessel at the disposal of the Royal Society; and I undertook the first scientific cruise in H M. surveying-ship *Porcupine* This cruise was off the western coast of Ireland, and the greatest depth dredged was 1476 fathoms The second cruise was undertaken by Prof Wyville Thomson, and extended from the south of Ireland to what is probably the deepest part of the North Atlantic in the European seas. The greatest depth dredged by him was 2435 fathoms, or nearly three miles The third cruise, under the charge of Dr. Carpenter, was in the same direction as the *Lightning* expedition, but embraced a larger area, including the Shetland Isles, the greatest depth was 867 fathoms. In the following year (1870) the *Porcupine* was again placed at the disposal of the Royal Society for further exploration. This expedition was divided into two cruises, North Atlantic and Mediterranean. The former was assigned to me, and comprised the sea-bed lying between Falmouth and the Straits of Gibraltar, along the western coasts of Spain and Portugal There were 38 dredging and sounding stations, at depths ranging from 81 to 1095 fathoms The Mediterranean cruise was made by Dr Carpenter, and extended round Sicily There were 29 stations, at depths ranging from 51 to 1743 fathoms. Prof. Wyville Thomson was unfortunately prevented by illness from taking part in this year's expedition. In all these cruises an abundance as well as a great variety of marine life occurred at every depth.

The *Lightning* and *Porcupine* expeditions culminated in the celebrated voyage of H M.S. *Challenger* round the world, which commenced on December 21, 1872, and ended on May 24, 1876, having thus occupied a period of three years and five months. During this expedition about 30,000 nautical miles were traversed, 504 soundings were taken, and 132 dredgings and 150 trawlings were made. The depths of soundings were from 25 to 4475, of dredgings from 4 to 3875, and of trawlings from 10 to 3050 fathoms. The greatest depth reached was five statute miles The Americans have recorded a greater depth, viz. 5¼ miles, or 4620 fathoms Even greater depths than this have been given, but they are not now considered reliable, by reason of the imperfect machinery which was formerly used for sounding

The *Proceedings* of the Royal Society for 1873 1877 contain many "Preliminary Reports" by Sir Wyville Thomson and the other naturalists attached to the *Challenger* expedition; so that all the scientific world were from time to time kept informed of the progress and results of this great national undertaking

During the last of our arctic voyages, in 1875, I had, through the influence and energy of the Royal Society, another opportunity of exploring a part of the North-Atlantic sea-bed which was not within the limits of the *Challenger* expedition; and I was intrusted with the scientific charge of the sounding and dredging conducted in H M S *Valorous* between Bantry Bay and Hare Island in Davis Strait This ship accompanied the *Alert* and *Discovery* on their way northwards After a voyage of three months, which was rendered more eventful by a cyclonical storm and a partial shipwreck on the coast of Greenland, we succeeded in working sixteen stations, with depths of from 20 to 1785 fathoms Here also, and even in the midst of icebergs, submarine life showed no diminution in number or extent.

To this short recital of our later expeditions I must not omit to add a notice of the valuable and suggestive researches which were accomplished under considerable difficulties by Dr. Wallich in H M S. *Bulldog* in 1860, while she was engaged in surveying the North Atlantic sea-bed for the purpose of establishing telegraphic communication between this country and North America The results of these researches were published in Dr Wallich's important work, entitled "The North-Atlantic Sea-bed, comprising a Diary of the Voyage on board H M S *Bulldog* in 1860, and observations on the presence of Animal Life, and the Formation and Nature of Organic Deposits at Great Depths in the Ocean" On the return voyage, about midway between Cape Farewell and Rockall, thirteen starfishes came up from a sounding of 1260 fathoms, "convulsively embracing a portion of the sounding-line which had been payed out in excess of the already ascertained depth, and rested for a sufficient period at the bottom to permit of their attaching themselves to it."

A short voyage in H.M S *Shearwater* through the Mediterranean in 1871 enabled Dr Carpenter to have some dredging between Sicily and the northern coast of Africa, on the Adventure and Skerki Banks. This dredging was by no means unproductive; but the depths did not exceed 200 fathoms, which we are now inclined to call "shallow water", Dr Carpenter's word was "shallows." Fifty years ago such depths would have been regarded by naturalists as peculiarly "abyssal"!

The elaborate report of my lamented friend Prof Edward Forbes, on the investigation of British Marine Zoology by means of the dredge, which he submitted to the British Association for the Advancement of Science in 1850, and to which I contributed as a humble fellow worker, was preceded by his equally valuable "Report on the Mollusca and Radiata of the Ægean Sea, and on their Distribution, considered as bearing on Geology" The last-mentioned Report was published by the Association in 1844. Forbes's conclusion that the sea-bottom at a depth of 300 fathoms is lifeless, because he found that life diminished gradually, and almost ceased when he dredged at 230 fathoms, has certainly been proved to be inaccurate as regards

[1] A Lecture by J. Gwyn Jeffreys, LL D, F R S

the ocean in general, but Dr Carpenter, in his Report to the Royal Society on his biological researches in the Mediterranean during the *Shearwater* cruise, expresses his belief that "in the Mediterranean basin the existence of animal life in any abundance at a depth greater than 200 fathoms will be found quite exceptional", and he infers "that Edward Forbes was quite justified in the conclusion he drew *as regards the particular locality he had investigated*, and that his only mistake lay in supposing that the same conditions would prevail in the open ocean." But this eminent naturalist and physiologist, Dr Carpenter, to whose opinions on such subjects all respect is due, admits that "the history of science is full of instances in which erroneous doctrines have been more *productive*, because more suggestive, than well-determined facts that open no access to the unknown beyond" With the greatest deference to Dr Carpenter's opinion that animal life is scanty in the depths of the Mediterranean, I venture to point out that very little had previously been done to investigate the fauna of that sea beyond the shores and shallow water to the extent which Forbes reached, viz. 230 fathoms.

Admiral Spratt in 1846 dredged, at a depth of 310 fathoms, 40 miles east of Malta, a number of living Mollusca, which I examined and found to be identical with species which I dredged at considerable depths in the North Atlantic during the *Porcupine* expeditions Again, during the Mediterranean cruise of 1870 in the *Porcupine*, no fewer than 14 species of Mollusca (also Atlantic), besides a pelagic or surface-water species and a small freshwater shell, which must have been carried out to sea by some river or stream, occurred at a depth of 1415 fathoms, between the coasts of North Africa and Spain. All these species were recent, and some were living, although most of them were known to me as also belonging to the Pliocene formation in Sicily However, we shall in all probability know a great deal more of this matter if our good neighbours the French are able to carry out their idea of extending their investigation of the deep sea near their own coasts by another dredging and sounding cruise off Marseilles or Toulon

During the early part of the summer in the present year (1880) our Admiralty placed at the disposal of Sir Wyville Thomson H M. surveying-vessel *Knight Errant* for a cruise off the Butt of Lewis, in prosecution of his researches in the *Lightning* Expedition as to the "warm" and "cold" areas which were noticed in the Report of that expedition Mr Murray took the scientific charge of the cruise, but the weather was boisterous, and unfavourable for dredging and trawling There were, however, some zoological results of an interesting kind, especially as regards the Mollusca, and it is hoped that the application which has now been made by the Royal Society for another Government vessel will be successful, and will enable Sir Wyville to continue the work and make further discoveries

Although we have of late years done a great deal to promote submarine researches, as shown by the expeditions of H M.SS. *Bulldog*, *Lightning*, *Porcupine*, *Shearwater*, *Valorous*, and *Knight Errant*, our comparatively poor neighbours in Scandinavia have been earlier in the field and not less energetic. From the "Notices sur la Suède," published on the occasion of the International Congress of Geographical Sciences in 1875 at Paris, it appears that between the years 1837 and 1875 seventeen scientific expeditions were made from Sweden, fifteen of which explored the Arctic regions. Professors Loven, Torell, and Nordenskjold, with other distinguished naturalists, took an active part in these expeditions The sister kingdom of Norway has since engaged in the same course of discovery, and a well-equipped Government vessel, the *Voringen*, of the same size as the *Porcupine* (about 400 tons), left Bergen in the beginning of June, 1876 Dr Danielssen, Professor Mohn and G O Sars, Herr Friele, and other scientific men accompanied the vessel, and were engaged in the zoological and physical work Through the kindness of my friend Prof. Sars I am enabled to give the following particulars of these Norwegian expeditions:—They occupied nearly three months in each of the years 1876, 1877, and 1878. The first expedition was divided into three cruises, and extended along the western coast of Norway to the Faroe Isles and Iceland There were 24 dredging-stations, at depths of from 90 to 1862 fathoms, besides 5 shore stations in Norway, Faroe, and Iceland The second expedition was divided into four cruises, and extended from Bergen to outside the Loffoden Isles, and from Tromso to Jan Mayen, there were 28 stations, with depths of from 70 to 1760 fathoms, besides 6 shore stations in Norway and Jan Mayen The third expedition was divided into three cruises, and extended to Vardo, and thence westward to Beeren Island, and afterwards to Spitzbergen in 80° N lat. The last expedition had 36 stations, with depths of from 21 to 1686 fathoms, besides 7 shore stations on the Arctic coasts of Norway, and in Beeren Island and Spitzbergen

The United States have prosecuted this kind of research with their well-known activity and perseverance From 1867 to the autumn of 1880 four Government steamers have been continuously employed in surveying the seas which border the coasts of Central and South America. Several hundred stations were investigated, at depths ranging from 6 to 2412 fathoms Count Pourtales, Prof Agassiz, and his no less eminent son, have been successively in charge of the scientific department. The results are both extensive and invaluable In 1871 I was invited by the late Prof Agassiz to pay him a visit and examine the Mollusca which had been procured during the previous years. The collection was in the custody of the late Prof. Stimpson at Chicago. It was extremely interesting to me, in connection with the expeditions of the *Lightning* and *Porcupine* I examined the collection in the Museum at Chicago, and, at the request of Prof Agassiz, I took home with me several of the shells for comparison with my own On my return to England, after enjoying the kind hospitality of my scientific friends in the United States and Canada, I learnt that Chicago had been utterly burnt down, and I was fortunately enabled to restore the shells, which were the only specimens of natural history that had been saved from the fire Through the kindness of Prof Spencer Baird, I had, during this visit to America, an opportunity of joining in a dredging excursion on the coast of New England, which was conducted under the auspices of the Fishery Commission.

Like a giant refreshed, France has awakened from a rather long sleep, and, with its accustomed spirit, has now rivalled all other nations in deep-sea work Last summer a scientific commission was appointed, with the venerable Prof Milne-Edwards as its president, and a large and well-equipped Government steamer, the *Travailleur*, explored the Bay of Biscay with most favourable results I was obligingly asked to take part in this expedition, and I gave an account of it at the last meeting of the British Association at Swansea, which is published in the Report of that meeting

Austria, Germany, and Holland have also not been last in the race of maritime voyages, although they have not contributed much to our knowledge of deep sea life

The harvest reaped in all the above-mentioned expeditions was most abundant and valuable

But after all it must be borne in mind that if every civilised nation in the world were every year, during the next century, to send out similar expeditions, with improved appliances, for exploring the sea-bed, the field would be far from being exhausted Every such expedition must be more or less tentative, and can only form the basis for a more complete investigation of "the deep bosom of the ocean" The area of investigation must be measured by many millions of square leagues, whereas all that has hitherto been effected has been to scrape in an imperfect manner the surface of a few scores of acres

I here exhibit charts to show the tracks of the expeditions in which I have been personally engaged, as well as those of the *Challenger* and Norwegian expeditions

2 *Apparatus*—The sounding-line, ropes, dredge, trawl, tangles, towing-net, sieves, accumulators, steam-engines, and other contrivances for deep sea exploration have been so fully described and illustrated in the "Depths of the Sea" and Capt. Sigsbee's "Deep-sea Sounding and Dredging," that it is unnecessary for me to do more than mention those books The latest improvements consist in the substitution of steel-wire for line in sounding, and of galvanised wire-rope for hempen rope in dredging and trawling Capt Sigsbee's new towing-net for ascertaining whether floating or swimming animals are found in any zone or belt of water lying between the surface and the bottom will be hereafter noticed It is still a desideratum to invent a dredge for deep-sea work which shall scrape the surface instead of sinking into the ooze or mud.

3 *Fauna.*—This word is used by naturalists to denote animal life in contradistinction to "Flora" or vegetable life All the recent exploring expeditions have established the fact that animal life of various kinds abounds everywhere in the deepest parts of the ocean. Nor is such life microscopic or minute only In the *Challenger* voyage was procured by the trawl, at the depth

of 1600 fathoms, in the South Atlantic (S. lat. 46° 16′, E. long. 48° 27′), a living specimen of a magnificent shell belonging to *Cymbium*, or an allied genus, which is 6¾ inches long and 4 inches broad! I dredged other Mollusca from an inch and a half to nearly double that length in the *Porcupine* and *Valorous* expeditions. Willemoes Suhm mentions among the *Challenger* discoveries a gigantic crustacean or sea-spider from 1375 fathoms, which measured nearly two feet across the legs.

Sir Wyville Thomson gives an eloquent description of life in the deep sea, when he says that the latter "is inhabited by a fauna more rich and varied on account of the enormous extent of the area, and with the organisms in many cases apparently even more elaborately and delicately formed, and more exquisitely beautiful in their soft shades of colouring, and in the rainbow tints of their wonderful phosphorescence, than the fauna of the well-known belt of shallow water teeming with innumerable invertebrate forms which fringes the land. And the forms of these hitherto unknown living beings, and their mode of life, and their relations to other organisms whether living or extinct, and the phenomena and laws of their geographical distribution, must be worked out."

It was formerly supposed that animals could not exist at great depths because of the great pressure to which they were subjected. Mr. Moseley says[1] "the pressure exerted by the water at great depths is enormous, and almost beyond comprehension. It amounts roughly to a ton weight on the square inch for every 1000 fathoms of depth, so that, at the depth of 2500 fathoms, there is a pressure of two tons and a half per square inch of surface, which may be contrasted with the fifteen pounds per square inch pressure to which we are accustomed at the level of the sea." But it must be recollected that water is nearly incompressible, and that marine animals which are surrounded by such a fluid, and are to a certain extent filled with it, would not necessarily be inconvenienced by the superincumbent weight.

Animals from great or even from what may be considered moderate depths are always brought up dead, the cause of death being unknown. This is another problem worthy of being worked out.

The migration or distribution of marine animals throughout the open sea is quite free, and is unobstructed only by great or abrupt changes of level in the bed of the ocean, which operate as barriers. Even animals of a fixed or sedentary nature in their earliest state of growth swim on the surface, and are therefore unchecked in their onward course by any submarine barrier.

The doubt whether any life exists in the intermediate space or zone which lies between that of the surface and that of the bottom of the deep sea has now, I believe, been set at rest. The naturalists in the *Josephine* expedition believed that this intermediate zone is lifeless, and Sir Wyville Thomson seems to have been of the same opinion. The towing-net adopted by Mr. Murray in the *Challenger* expedition for such researches was to some extent successful, but Capt. Sigsbee, of the U.S. Coast Survey steamer *Blake*, invented a cylinder or machine, called the "gravitating trap," which completely answered the purpose of collecting at any particular depth the animals which occurred there. Prof. Alexander Agassiz, in his communication to the Superintendent of the Survey made last August, and now published, records the experiments thus made, and says that they "appear to prove conclusively that the surface-fauna of the sea is really limited to a comparatively narrow belt in depth, and that there is no intermediate belt, so to speak, of animal life between those living on the bottom, or close to it, and the surface pelagic fauna."

I am not aware that any deep-sea animals adopt or avail themselves of the same means that oceanic or land animals use for purposes of protection and concealment, chiefly by coloration or by what has been termed "mimicry." Many cases of this kind are known to occur in birds, fishes, mollusks, *Salpæ*, insects, crabs, shrimps, and worms.

None of the animals whose remains are found in geological formations older than the Pliocene or latest of the Tertiary strata have yet been detected in any exploring expedition. The late Prof. Agassiz and Sir Wyville Thomson were disappointed in their enthusiastic expectation of finding Ammonites, Belemnites, and other Old-World fossils in a living state. I have dredged Miocene fossils on the coasts of Guernsey and Portugal, the latter at considerable depths; but they were petrifactions, and must have come from some fossiliferous formation in the adjacent land, or perhaps in the sea-bed.

[1] "Notes of a Naturalist on the *Challenger*."

Sir Wyville Thomson, in his "Report of the Scientific Results of the Voyage of H.M.S. *Challenger*," has expressed his opinion as to the doctrine of evolution, that "in this, as in all cases in which it has been possible to bring the question, however remotely, to the test of observation, the character of the abyssal fauna refuses to give the least support to the theory which refers the evolution of species to extreme variation guided only by natural selection." I cannot understand how either "natural selection" or "sexual selection" can affect marine invertebrate animals, which have no occasion to struggle for their existence and have no distinction of sex.

(*To be continued.*)

THE RELATION BETWEEN ELECTRICITY AND LIGHT[1]

EVER since the subject on which I have the honour to speak to you to-night was arranged, I have been astonished at my own audacity in proposing to deal in the course of sixty minutes with a subject so gigantic and so profound that a course of sixty lectures would be quite inadequate for its thorough and exhaustive treatment.

I must indeed confine myself carefully to some few of the typical and most salient points in the relation between electricity and light, and I must economise time by plunging at once into the middle of the matter without further preliminaries.

Now when a person is setting off to discuss the relation between electricity and light it is very natural and very proper to pull him up short with the two questions: What do you mean by electricity? and What do you mean by light? These two questions I intend to try briefly to answer. And here let me observe that in answering these fundamental questions I do not necessarily assume a fundamental ignorance on your part of these two agents, but rather the contrary, and must beg you to remember that if I repeat well-known and simple experiments before you, it is for the purpose of directing attention to their real meaning and significance, not to their obvious and superficial characteristics: in the same way that I might repeat the exceedingly familiar experiment of dropping a stone to the earth if we were going to define what we meant by gravitation.

Now then we will ask first, What is Electricity? and the simple answer must be, We don't know. Well, but this need not necessarily be depressing. If the same question were asked about Matter, or about Energy, we should have likewise to reply, No one knows.

But then the term Matter is a very general one, and so is the term Energy. They are heads, in fact, under which we classify more special phenomena.

Thus if we were asked what is sulphur, or what is selenium, we should at least be able to reply, A form of matter; and then proceed to describe its properties, *i.e.* how it affected our bodies and other bodies.

Again, to the question, What is heat? we can reply, A form of energy, and proceed to describe the peculiarities which distinguish it from other forms of energy.

But to the question, What is electricity? we have no answer pat like this. We cannot assert that it is a form of matter, neither can we deny it; on the other hand, we certainly cannot assert that it is a form of energy, and I should be disposed to deny it. It may be that electricity is an entity *per se*, just as matter is an entity *per se*.

Nevertheless I can tell you what I mean by electricity by appealing to its known behaviour.

Here is a battery, that is, an electricity pump: it will drive electricity along. Prof. Ayrton is going, I am afraid, to tell you, on the 20th of January next, that it *produces* electricity, but if he does, I hope you will remember that that is exactly what neither it nor anything else can do. It is as impossible to generate electricity in the sense I am trying to give the word, as it is to produce matter. Of course I need hardly say that Prof. Ayrton knows this perfectly well; it is merely a question of words, *i.e.* of what you understand by the word electricity.

I want you then to regard this battery and all electrical machines and batteries as kinds of electricity pumps, which drive the electricity along through the wire very much as a water-pump can drive water along pipes. While this is going on the wire manifests a whole series of properties, which are called the properties of the current.

[1] A lecture by Dr. O. J. Lodge, delivered at the London Institution on December 16, 1880.

[Here were shown an ignited platinum wire, the electric arc between two carbons, an electric machine spark, an induction coil spark, and a vacuum tube glow. Also a large nail was magnetised by being wrapped in the current, and two helices were suspended and seen to direct and attract each other.]

To make a magnet, then, we only need a current of electricity flowing round and round in a whirl. A vortex or whirlpool of electricity is in fact a magnet, and *vice versâ*. And these whirls have the power of directing and attracting other previously existing whirls according to certain laws, called the laws of magnetism. And, moreover, they have the power of exciting fresh whirls in neighbouring conductors, and of repelling them according to the laws of diamagnetism. The theory of the actions is known, though the nature of the whirls, as of the simple stream of electricity, is at present unknown.

[Here was shown a large electro-magnet and an induction coil vacuum discharge spinning round and round when placed in its field.]

So much for what happens when electricity is made to travel along conductors, *i.e.* when it travels along like a stream of water in a pipe, or spins round and round like a whirlpool.

But there is another set of phenomena, usually regarded as distinct, and of another order, but which are not so distinct as they appear, which manifest themselves when you join the pump to a piece of glass or any non-conductor and try to force the electricity through that. You succeed in driving some through, but the flow is no longer like that of water in an open pipe; it is as if the pipe were completely obstructed by a number of elastic partitions, or diaphragms. The water cannot move without straining and bending these diaphragms, and if you allow it, these strained partitions will recover themselves and drive the water back again. [Here was explained the process of charging a Leyden jar.] The essential thing to remember is that we may have electrical energy in two forms, the static and the kinetic, and it is therefore also possible to have the rapid alternation from one of these forms to the other, called vibration.

Now we will pass to the second question: What do you mean by light? And the first and obvious answer is, Everybody knows. And everybody that is not blind does know to a certain extent. We have a special sense organ for appreciating light, whereas we have none for electricity. Nevertheless, we must admit that we really know very little about the intimate nature of light—very little more than about electricity. But we do know this, that light is a form of energy, and, moreover, that it is energy rapidly alternating between the static and the kinetic forms—that it is, in fact, a special kind of energy of vibration. We are absolutely certain that light is a periodic disturbance in some medium, periodic both in space and time; that is to say, the same appearances regularly recur at certain equal intervals of distance at the same time, and also present themselves at equal intervals of time at the same place; that in fact it belongs to the class of motions called by mathematicians undulatory or wave motions. The wave motion in this model (Powell's wave apparatus) results from the simple up-and-down motion popularly associated with the term *wave*. But when a mathematician calls a thing a wave he means that the disturbance is represented by a certain general type of formula, not that it is an up-and-down motion, or that it looks at all like those things on the top of the sea. The motion of the surface of the sea falls within that formula, and hence is a special variety of wave motion, and the term wave has acquired in popular use this signification and nothing else. So that when one speaks ordinarily of a wave or undulatory motion one immediately thinks of something heaving up and down, or even perhaps of something breaking on the shore. But when we assert that the form of energy called light is *undulatory*, we by no means intend to assert that anything whatever is moving up and down, or that the motion, if we could see it, would be anything at all like what we are accustomed to in the ocean. The kind of motion is unknown; we are not even sure that there is anything like motion in the ordinary sense of the word at all.

Now how much connection between electricity and light have we perceived in this glance into their natures? Not much truly. It amounts to about this: That on the one hand electrical energy may exist in either of two forms—the static form, when insulators are electrically strained by having had electricity driven partially through them (as in the Leyden jar), which strain is a form of energy because of the tendency to discharge and do work; and the kinetic form, where electricity is moving bodily along through conductors or whirling round and round inside them, which motion of electricity is a form of energy, because the conductors and whirls can attract or repel each other and thereby do work.

And, on the other hand, that light is the rapid alternation of energy from one of these forms to the other—the static form where the medium is strained, to the kinetic form when it moves. It is just conceivable then that the static form of the energy of light is *electro*-static, that is, that the medium is *electrically* strained, and that the kinetic form of the energy of light is *electro*-kinetic, that is, that the motion is not ordinary motion, but electrical motion—in fact that light is an electrical vibration, not a material one.

On November 5 last year there died at Cambridge a man in the full vigour of his faculties—such faculties as do not appear many times in a century—whose chief work has been the establishment of this very fact, the discovery of the link connecting light and electricity; and the proof (for I believe it amounts to a proof)—that they are different manifestations of one and the same class of phenomena—that light is, in fact, an electro-magnetic disturbance. The premature death of James Clerk Maxwell is a loss to science which appears at present utterly irreparable, for he was engaged in researches that no other man can hope as yet adequately to grasp and follow out; but fortunately it did not occur till he had published his book on "Electricity and Magnetism," one of those immortal productions which exalt one's idea of the mind of man, and which has been mentioned by competent critics in the same breath as the "Principia" itself.

But it is not perfect like the "Principia"; much of it is rough hewn, and requires to be thoroughly worked out. It contains numerous misprints and errata, and part of the second volume is so difficult as to be almost unintelligible. Some, in fact, consists of notes written for private use, and not intended for publication. It seems next to impossible now to mature a work silently for twenty or thirty years, as was done by Newton two and a half centuries ago. But a second edition was preparing, and much might have been improved in form if life had been spared to the illustrious author.

The main proof of the electro-magnetic theory of light is this. The rate at which light travels has been measured many times, and is pretty well known. The rate at which an electro-magnetic wave disturbance would travel if such could be generated (and Mr. Fitzgerald of Dublin thinks he has proved that it cannot be generated directly by any known electrical means) can be also determined by calculation from electrical measurements. The two velocities agree exactly. This is the great physical constant known as the ratio V, which so many physicists have been measuring, and are likely to be measuring for some time to come.

Many and brilliant as were Maxwell's discoveries, not only in electricity, but also in the theory of the nature of gases, and in molecular science generally, I cannot help thinking that if one of them is more striking and more full of future significance than the rest, it is the one I have just mentioned—the theory that light is an electrical phenomenon.

The first glimpse of this splendid generalisation was caught in 1845, five and thirty years ago, by that prince of pure experimentalists, Michael Faraday. His reasons for suspecting some connection between electricity and light are not clear to us—in fact they could not have been clear to him; but he seems to have felt a conviction that if he only tried long enough, and sent all kinds of rays of light in all possible directions across electric and magnetic fields in all sorts of media, he must ultimately hit upon something. Well, this is very nearly what he did. With a sublime patience and perseverance which remind one of the way Kepler hunted down guess after guess in a different field of research, Faraday combined electricity, or magnetism, and light in all manner of ways, and at last he was rewarded with a result. And a most out-of-the-way result it seemed. First you have to get a most powerful magnet and very strongly excite it; then you have to pierce its two poles with holes, in order that a beam of light may travel from one to the other along the lines of force; then, as ordinary light is no good, you must get a beam of plane polarised light and send it between the poles. But still no result is obtained until, finally, you interpose a piece of a rare and out-of-the-way material which Faraday had himself discovered and made, a kind of glass which contains borate of lead, and which is very heavy, or dense, and which must be perfectly annealed.

And now, when all these arrangements are completed, what is

seen is simply this, that if an analyser is arranged to stop the light and make the field quite dark before the magnet is excited, then directly the battery is connected and the magnet called into action a faint and barely perceptible brightening of the field occurs; which will disappear if the analyser be slightly rotated. [The experiment was then shown] Now no wonder that no one understood this result. Faraday himself did not understand it at all: he seems to have thought that the magnetic lines of force were rendered luminous, or that the light was magnetised, in fact he was in a fog, and had no idea of its real significance. Nor had any one. Continental philosophers experienced some difficulty and several failures before they were able to repeat the experiment. It was in fact discovered too soon, and before the scientific world was ready to receive it, and it was reserved for Sir William Thomson briefly, but very clearly, to point out, and for Clerk Maxwell more fully to develop, its most important consequences. [The principle of the experiment was then illustrated by the aid of a mechanical model.]

This is the fundamental experiment on which Clerk Maxwell's theory of light is based, but of late years many fresh facts and relations between electricity and light have been discovered, and at the present time they are tumbling in in great numbers.

It was found by Faraday that many other transparent media besides heavy glass would show the phenomenon if placed between the poles, only in a less degree, and the very important observation that air itself exhibits the same phenomenon, though to an exceedingly small extent, has just been made by Kundt and Rontgen in Germany.

Dr Kerr of Glasgow has extended the result to opaque bodies, and has shown that if light be passed through magnetised *iron* its plane is rotated. The film of iron must be exceedingly thin, because of its opacity, and hence, though the intrinsic rotating power of iron is undoubtedly very great, the observed rotation is exceedingly small and difficult to observe, and it is only by very remarkable patience and care and ingenuity that Dr Kerr has obtained his result. Mr Fitzgerald of Dublin has examined the question mathematically, and has shown that Maxwell's theory would have enabled Dr Kerr's result to be predicted.

Another requirement of the theory is that bodies which are transparent to light must be insulators or non-conductors of electricity, and that conductors of electricity are necessarily opaque to light. Simple observation amply confirms this; metals are the best conductors, and are the most opaque bodies known. Insulators such as glass and crystals are transparent whenever they are sufficiently homogeneous, and the very remarkable researches of Prof Graham Bell in the last few months have shown that even *ebonite*, one of the most opaque insulators to ordinary vision, is certainly transparent to some kinds of radiation, and transparent to no small degree.

[The reason why transparent bodies must insulate, and why conductors must be opaque, was here illustrated by mechanical models.]

A further consequence of the theory is that the velocity of light in a transparent medium will be affected by its electrical strain constant; in other words, that its refractive index will bear some close but not yet quite ascertained relation to its specific inductive capacity. Experiment has partially confirmed this, but the confirmation is as yet very incomplete. But there are a number of results not predicted by theory, and whose connection with the theory is not clearly made out. We have the fact that light falling on the platinum electrode of a voltameter generates a current, first observed, I think, by Sir W. R. Grove—at any rate it is mentioned in his "Correlation of Forces"—extended by Becquerel and Robert Sabine to other substances, and now being extended to fluorescent and other bodies by Prof. Minchin. And finally—for I must be brief—we have the remarkable action of light on selenium. This fact was discovered accidentally by an assistant in the laboratory of Mr. Willoughby Smith, who noticed that a piece of selenium conducted electricity very much better when light was falling upon it than when it was in the dark. The light of a candle is sufficient, and instantaneously brings down the resistance to something like one-fifth of its original value.

I could show you these effects, but there is not much to see; it is an intensely interesting phenomenon, but its external manifestation is not striking—any more than Faraday's heavy glass experiment was.

This is the phenomenon which, as you know, has been utilised by Prof. Graham Bell in that most ingenious and striking invention, the photophone. By the kindness of Prof. Silvanus Thompson I have a few slides to show the principle of the invention, and Mr Shelford Bidwell has been good enough to lend me his home-made photophone, which answers exceedingly well for short distances.

I have now trespassed long enough upon your patience, but I must just allude to what may very likely be the next striking popular discovery, and that is the transmission of light by electricity; I mean the transmission of such things as views and pictures by means of the electric wire. It has not yet been done, but it seems already theoretically possible, and it may very soon be practically accomplished.

ENDOWMENT OF RESEARCH IN BIRMINGHAM

THE President of the Birmingham Philosophical Society, Dr Heslop, recently gave an address to the members, taking for his subject the "Scientific Situation in Birmingham." Having reviewed the various local agencies set up during the past year for the diffusion of knowledge, including the opening of Mason's Science College, he went on to say: I must now allude to the most important work undertaken by the Society, the establishment of the fund for the endowment of research. This action has received warm support in many quarters, and has in fact done more to place it in a favourable light before the country than any previous circumstances. Although the efforts made to raise this fund have been inconsiderable, yet nearly 100*l.* in annual subscriptions, of varying dates, and 900*l.* in donations have been obtained. The Council have invested 600*l.* in order to ensure the permanence of the fund. It is probable that some slight additions may be made to this sum, having the same object in view; but it is, I believe, their intention to recommend the Society to spend the whole income, howsoever derived, in annual grants to persons living in this town or neighbourhood who devote themselves wholly or in part to science research. It is an error to suppose that this fund is to be allotted either to any particular individual or specially to members of this Society. The Council are free to do what they deem best with the money intrusted to them, within the limits of the scheme agreed upon. There is another temporary limit to their powers. One eminent investigator (Dr. Gore) is allotted a certain sum for a certain period. The approval of this step evinced by those who have contributed to the fund, and by others, has been a source of satisfaction to the Council.

I wish now to remind you that the scheme in connection with this subject declares that "the Council are of opinion that this Society would be omitting a principal means of the advancement of science—the end for which all such associations exist—if it neglected the question of the endowment of research. To maintain a successful investigator in his labours, even though no results of immediate or obvious utility can be shown to spring out of them, is of interest to the community at large." It may be that you will pronounce these words to be truisms scarcely requiring formal enunciation. The fact is that though the sense of them has been repeatedly given to the public in late years, practical action has not ensued. Everybody is telling his neighbour what a good thing it would be if men endowed with an aptitude for research into the facts of nature were also endowed with the means of living during their work. The speaker and the listener go by on the other side, and no good Samaritan tenders help to the well-praised searcher after truth. Nay, Mr. Mark Pattison affirms in his late book on Milton that "the England of our day has decided against the endowment of science," and seems to think that the principle on which the decision is based may be wrong, but "is not unreasonable." But the endowment of ministers of science stands on quite another foundation from that of ministers of religion. "To assign a place with a salary," says Mr. Pattison, "is to offer a pecuniary inducement to simulate" the qualification, *i.e.* a state of grace. But in the case of science there is no question of place, and the endowment is offered, not to those who promise much, but to those who have already performed something; not to those who imagine themselves to be in the requisite spiritual state, but to those who, working for an audience, select though few, have demonstrated that they are touched by the divine fire which burns not for other men.

In the opinion of others the only practicable mode of dealing with this question is by bestowing adequate funds on teachers, and by placing them in favourable conditions for research.

The necessity for making provision for the devotion of fit men to scientific work has occurred to many, and doubtless private generosity has often enabled such men to prosecute labours by which the world has greatly gained. One of the most striking instances is that of Priestley. His own remarks contained in his diary are full of interest He says that Dr. Fothergill "having observed that many of my experiments had not been carried to their proper extent on account of the expense that would have attended them," proposed a subscription from himself and some of his friends, and named 100*l* per annum He consented to receive 40*l*, which was regularly paid to him, three other gentlemen aiding Afterwards for good reasons Fothergill proposed "an enlargement of the allowance for my experiments, and likewise for my maintenance, *without being under the necessity of giving my time to pupils*, which I must otherwise have done" This was accepted, as Priestley preferred it to any pension from the Court He gives a minute list of the numerous donations, legacies (one of 2000*l*) and subscriptions given to him, while he dilates on Mr Wedgwood's gifts of pottery, retorts, tubes, &c, and presents in glass from another gentleman, among which figures "a capital burning lens, sixteen inches in diameter" The Duke of Grafton remitted him annually 40*l* When he went to America forty of his friends, without solicitation, raised the sum of 450*l*, "which was meant to have been continued annually while he lived," as stated by his son.

You will hear these details with the interest naturally belonging to the subject, and doubtless ask the question, Have succeeding generations improved on this? I believe that there is no example of an equal generosity on the part of their fellow-countrymen to a man of science, although there are some agreeable exceptions to the rule of neglect A few years ago the Fishmongers' Company presented the sum of 50*l* to Prof Parker, and an annual gift of 20*l* for three years, to assist him in bearing the expenses of his researches on vertebrate animals For three years the British Pharmaceutical Society voted 80*l* in aid of pharmaceutical research The principle of promoting research has also been recognised by the Government in their grant of 1000*l*, and in the fund of 4000*l* placed at the disposal of the Royal Society Our Government has, however, as yet made no payment for the *labour* of pure research in experimental physics or chemistry "A grant from the above sum," says Dr Gore, "is often an unprofitable gift to accept, because it is in some cases only sufficient to pay expenses out of pocket for chemicals and apparatus, and allows nothing for skill or labour."

The mention of our able associate's name compels me to draw attention to the invaluable services he has rendered for ten years past to the cause of the endowment of research His numerous articles and papers form a repository of facts and arguments of which I have largely availed myself Any one who studies them will need no other evidence of the importance of the question, both in view of the progress of truth and of the maintenance of our national welfare In one of them he mentions the difficulty experienced in the proper employment of the Government money, and proceeds as follows —"By far the greater part of the expense of an investigation in physics or chemistry is the exceedingly large amount of time it occupies Many necessary preliminary experiments have to be made, which yield either negative, unsuccessful, or incomplete results, and make the undertaking expensive" Further, "By order of the Council, all instruments, apparatus, and drawings, made or obtained by aid of the Government grants, shall, after serving the purpose for which they were procured, and in the absence of any undertaking to the contrary, be delivered into the custody of the Royal Society"

Research, then, in any fair sense of the word may be said to be unprovided for by public funds. The British Association annually bestows grants of varying amounts for specific researches The Royal Institution helps. Yet we feel surprised when told that the average annual expenses relating to experimental research, including salaries to assistants in the laboratory, from the year 1867 to 1871, did not amount to two hundred and fifty pounds.

When it is remembered that not a single college, nor even a professorship, for pure scientific research exists in this country, we must feel humiliated when we cast a glance at what is going on in other countries. In France and Germany varied resources have been placed at the disposal of men of science, which I cannot now minutely specify Nor will I delay to speak in detail of the importance of pure research in science, of the mighty material results as regards our comfort and national wealth which have sprung from the labours of men of science, for it may be assumed that all this is known It is certain too that valuable inventions in various arts and manufactures will follow upon fresh discoveries regarding the principles involved in them When we know more of the materials and forces of nature, new applications of them will soon follow. The progress of invention depends upon that of discovery, the various inventions wanted by manufacturers and others cannot be perfected until "suitable knowledge is found" The money of the capitalist, the hand of the inventor, await the products of the brains of the searcher after truth

It is only too well known that other countries have for some years past distanced Britain in the field of research, that while Germany is sending her trained sons to all parts of the world, we scarcely even supply our own colonies. A writer in the *Monthly Journal of Science* said last year that "to a very great extent, both in the home kingdoms and the colonies, we find ourselves compelled to import that intellectual eminence which we refuse to cultivate in our midst Foreigners occupy professorial chairs in our colleges, they fill the posts of botanists and geologists in our colonial governments, they hold high positions in the respective staffs of the British Museum, of the Geological Survey of India, and of our exploring expeditions"

Now as these results cannot be owing to any inbred deficiency in the countrymen of Newton, Faraday, and Darwin, it behoves us to ask if our educational system is at fault, and if fair provision is made for those able and willing to make original research. The latter question is already answered by the facts adduced How far our great universities have provided for science-teaching can be learned by reading between the lines of certain resolutions passed a few years ago by an "Association for the organisation of academical study," the composition of which was an ample guarantee of competence The resolutions were as follows —

"That the chief end to be kept in view in any redistribution of the revenues of Oxford and Cambridge is the adequate maintenance of nature study and scientific research, as well for their own sakes as with the view of bringing the higher education within the reach of all who are desirous of profiting by it"

"That to have a class of men whose lives are devoted to research is a national object"

"That it is desirable in the interests of national progress and education that *professorships* and *special institutions* shall be founded in the universities for the promotion of scientific research"

"That the present mode of awarding Fellowships as prizes, has been unsuccessful as a means of promoting nature study and original research, and that it is therefore desirable that it should be discontinued."

The state of things here pointed at has improved and is improving, yet the verdict of a candid observer must still be summed up in the one word inadequacy

Numerous suggestions have been made regarding the endowment of research, but most of them are unpractical Those who imagine that the object will be gained by establishing adequate teacherships of science, seem to be too sanguine The labour involved in the work of teaching, in the way of acquisition, preparation, and performance, is too great to permit the devotion of sufficient time and thought to the search after new truth If it is desirable that new facts and principles be searched after, why should fit inquirers be put, either partly or wholly, to other work? I know that many of our teachers have hitherto been at a great disadvantage, that managers of institutions have had a sharper eye on their prospectus than on their internal arrangements, that they have thought of a college rather as a body of bricks than as productive of a body of learning, and that apparatus and assistants, though well enough in Berlin or Leipzig, are needless in prudent England Yet the ideal Professor is rather the head of a department than a mere speaker by the yard of so many lectures, a man with numerous hands in the shape of demonstrators and assistants, themselves the possessors of well-trained brains, a director of work with all its apparatus freely supplied to him Such a man adequately remunerated may be safely left to his own tendencies. Contact with nature breeds the desire to know her better In favourable conditions the teacher becomes the investigator, and while seeking after new truth builds up his own fame

After all, however, the question recurs, how can we best promote research, as the undivided life's work of fit persons? I believe that the solution lies, so far as this time is concerned, in

the establishment of special institutions having no other object than the search after new truth Their administration would be difficult. The right men can be found for the work, but can the right electors be found? Ardent searchers after a more intimate knowledge of nature do still live, will ever live; but what of First Commissioners of Works like—but I need not name him? What of Lords of the Treasury who refused the request of a great physicist for 150*l* for the investigation of the tides? Yet these gentlemen assist in governing a maritime state of some importance. Such electors as these are not within my view, and, if they were, how of the detailed management? Men given up to research are not to be tied by the common rules of official life, to be compelled to report in annual blue books the exact measure of work they have done, to show how many drachms of oil of vitriol they have used, and account for every ounce of platinum.

Special institutions will be founded, but they will owe their origin to private individuals like Sir Josiah Mason, who, having taken into their confidence the chiefs of the world of science in making the appointments, will speak to the masters of research in this wise —

"I have built a house for you replete with every requirement for your work, I have provided you with such assistants as you have asked for; I have given you an income placing within your reach every reasonable comfort. Occupy your lives in the study of nature. If you succeed in your efforts to attain to new truth, the world will be the gainer If you fail, your efforts will be enough reward for me"

Such language as this will be surely one day heard In this fortunate town it is already heard During the past year a member of this Society, Mr Fulford, has taken a house, and, having admirably fitted it up, has handed it over to our two distinguished associates, Dr Gore and Dr Norris, in order that they may enjoy at least the requisite structural conveniences for the prosecution of research This building is called the "Institute of Scientific Research"

I must, however, remind you that this noble enterprise must be supplemented by some such efforts in the way of endowment as those now made by this Society, and that those who work even in the highest sphere are bound by the same necessities as bind other men

SCIENTIFIC SERIALS

Annalen der Physik und Chemie, No 12 (December, first No) —On the density and tension of saturated vapour, by A Wullner and O. Grotrian —On the application of the electrodynamic potential to determination of the ponderomotive and electromotive forces, by R. Clausius —On friction in free liquid surfaces, by A Oberbeck —Simple methods and instruments for resistance-measurements, especially in electrolytes, by F Kohlrausch —Influence of temperature on the phenomena of charge of a liquid cell acting as condenser, by H. Herwig.—On the modes of electric discharge in gases, by O Lehmann —On the electric discharge in liquid insulators, by W Holtz —On electric figures on the surface of liquids, by the same —On the increase of danger from lightning and its probable causes, by the same —On a microprismatic method for distinction of solid substances, by O Maschke —Note on Herr Weber's reply, by A Winkelmann.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti Vol. xii, fasc xix —The Leprosy of Upper Italy, especially of Comacchio (continued), by Prof. Sangalli.—Influence of traction and vibration of a metallic wire on its electric conductivity, by Dr de Marchi.—On a case of twisted neck; a contribution to the doctrine of transport of spinal influence and to establishment of a hypothesis for its explanation, by Prof. de Giovanni

Zeitschrift fur wissenschaftliche Zoologie, November, 1880, contains · Dr H. von Ihering, on the affinities and kinship of the Cephalopods —Dr J Bellonci, on the origin of the optic nerve and on the minute structure of the "tectum opticum" in the Teleostei (Plates 1 and 2).—Dr. D. Sochaczewer, on the organ of smell in the terrestrial pulmonates (Plate 3) —Dr. Fritz Muller, on the case-making Trichoptera larvæ of the Province of Santa Catharina (Plates 4 and 5), translated by his brother, Dr. Hermann Muller, from the memoirs in Portuguese in the Archivos de Museu National, Rio de Janeiro.—Dr. William Marshall, researches in the sponge groups, Dysideidæ and Phoriospongiæ (Plates 6 to 8).—Prof. Dr. Krause, on two very early human embryos (Plate 9).—Dr. H. Simroth, on the nervous system in the foot of *Paludina vivipara*, with a woodcut of the nerves as dissected out.

Revue internationale des Sciences biologiques, December 1880 contains:—A. de la Calle, on the formation of language (continued). —M. Decatte, microcephalism, from the point of view of atavism. —M. Zaborowski, historical sketch of the relative knowledge possessed by the ancients and in mediæval times of the large monkeys.—Notices of learned societies.—French Association for the Advancement of Science (the Rheims Meeting).—The Academy of Sciences, Paris

Schriften der physikalisch-okonomischen Gesellschaft zu Konigsberg (1877, ii., 1878, i and ii)—These parts contain the following papers —On Baron von Richthofen's loess theory and the alleged steppe character of Europe at the close of the Glacial period, by Dr. A. Jentzsch.—Observations of the station for measuring the temperature of the soil in various depths, at the Konigsberg Botanical Gardens, by Prof E Dorn —On the prehistoric-archæological work done by the Society, by Otto Tischler —On the commercial routes of the ancients to the amber country, by Dr. Krosta.—On the physics of the soil, by Dr von Liebenberg —On the discoveries in prehistoric tombs at Furstenwalde, by Otto Tischler.—On hair covered human beings and the abnormal growth of hair, by Prof Hildebrandt —On the marine fauna near the Prussian coast, by Prof. Zaddach — On the alleged steppe character of Central Europe, by Dr Jentzsch —On the state of civilisation in Denmark during the first centuries after Christ, by O. Tischler —On Darwin's theory, by Herr Czwalina —On East Prussian burial-grounds, by O. Tischler —On the fauna of Madagascar, by Prof Zaddach —On the intra-Mercurial planet, by Dr Franz —On the geological maps at the Paris Exhibition by Dr Jentzsch —On some special geological maps of Germany, by the same —On the principles of the kinetic theory of gases, by Dr. Saalschutz

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, January 20.—Prof H. E. Roscoe, president, in the chair —The president announced that the Faraday lecture would be delivered by Prof Helmholtz in the Royal Institution, On the Modern Development of Faraday's Conception of Electricity. The following papers were read —On pentathionic acid, by Mr. V Lewes The author has succeeded in obtaining beautifully crystallised barium and potassium pentathionates by partially neutralising Wackenroder's solution and evaporation *in vacuo* —A preliminary note on some hydrocarbons from rosin spirit, by Dr Armstrong Cymene, toluene, and metaxylene were found to be present The hydrocarbons insoluble in sulphuric acid are probably hexhydrides of hydrocarbons of the benzene series. The author does not consider that rosin is directly derived from terpene —On the determination of the relative weight of single molecules, by Dr Vogel of San Francisco —On the synthetical production of ammonia by the combination of hydrogen and nitrogen in presence of heated spongy platinum, by G S Johnson About 0 0144 grm of ammonia were obtained in two and a half hours —On the oxidation of organic matter in water, by A Downes.—Analyses of Queensland soils, by Prof. A. Liversidge. These analyses are interesting, as the soils include samples from districts which were exempt from the disease prevalent in the sugar plantations around —On the volumes of some compounds of the benzene naphthalene, anthracene, and phenanthrene series, by Dr. Ramsay.—On the atomic volume of nitrogen, by Dr Ramsay — On a new theory of the conversion of bar iron into steel by the cementation process, by Dr. Marsden. The author thinks that carbon diffuses in an impalpable powder through the heated iron. —On the action of sulphydrate of potassium on chloral hydrate, by W W J. Nicol Thioglyoxylic and thioformic acids are formed.

Zoological Society, January 18 —Prof. W. H. Flower, LL.D, F.R S., president, in the chair —The Secretary read a report on the additions that had been made to the Society's Menagerie during the month of December, 1880, amongst which special attention was called to a young female Red Wolf (*Canis jubatus*) from the Argentine Republic, presented by Mr. W. Petty of Monte Video, being the second example of this scarce animal received, and to a Pig from Brooker Island, Louisiade Archipelago, presented by Lieut de Hoghton, of H.M S.

Beagle.—A paper by Mr. P. L. Sclater and Dr. G. Hartlaub was read, on the birds collected in Socotra by Prof. I. B. Balfour in the early part of the year 1880. The collection contained 124 examples referable to thirty-four species. Of these seven of the Passeres appeared to be new, and were proposed to be called *Cisticola incana*, *Drymœca hæsitata*, *Lanius uncinatus*, *Cinnyris Balfouri*, *Passer insularis*, *Rhynchostruthus Socotranus*, and *Amydrus frater*.—Mr. A. G. Butler read a paper on the lepidoptera collected in Socotra by Prof. I. B. Balfour. The collection contained twenty-four specimens referable to thirteen species, seven of which were stated to be new to science.—Mr. W. A. Forbes read a paper on some points in the anatomy of the Koala (*Phascolarctos cinereus*), as observed in the specimen recently living in the Society's Gardens.—A communication was read from Mr. R. Bowdler Sharpe, in which was given the description of a new form of the family *Timeliidæ*, from Madagascar, proposed to be called *Neomixis*.—A communication was read from Dr. John Scully containing an account of the mammals of Gilgit, a district in the extreme north-western part of Kashmir. Thirty three species were enumerated, and notes on their vertical ranges and habits were added. The mammals of Gilgit were shown to consist of an intermixture of Central Asiatic and Himalayan species, as might have been expected from the position of the country. Two species (a Bat and a Vole), apparently new to science, were named respectively *Harpiocephalus tubinaris* and *Arvicola Blanfordi*.

Meteorological Society, January 19.—Mr. G. J. Symons, F.R.S., president, in the chair.—The report of the Council for the year 1880, which was read by the Secretary, refers to subjects of considerable importance, and affords substantial evidence of the interest taken in meteorology by the scientific and general public. Amongst these may be mentioned the great success of the new climatological stations, as shown by their increased number and by the regularity and care with which the observations have been made and recorded, and the returns forwarded to the Society. The Council also advert to the number of new and improved instruments exhibited at the meeting held in March last, to the increase in the number of Fellows, fifty-two having been elected during the year, and finally the numerous papers which have been sent to the Society from various parts of the world, embracing records of the climate of several important localities, respecting which but little has hitherto been known in this country.—After a vote of thanks had been passed to the Council for their services during the year, and to the Institution of Civil Engineers for allowing free use of their rooms, the President delivered his address, in which he traced the history of English meteorological societies from 1823 to 1880. The earliest English effort at forming an English meteorological society, or at any rate at securing observations made with comparable instruments recorded upon a uniform system, was made in 1723 by Dr. James Jurin, who was then secretary to the Royal Society. In the *Philosophical Transactions* for that year will be found a Latin address by Dr. Jurin, in which he anticipates nearly all the conditions which are now considered essential for comparable observations. This appeal did not lead to much being done, and in 1744 another attempt was made by Mr. Roger Pickering, F.R.S., who read before the Royal Society a paper entitled "Scheme of a Diary of the Weather, together with Drafts and Descriptions of Machines subservient thereunto." The Meteorological Society of the Palatinate was established in 1780 under the auspices of the Elector Charles Theodore, who not only gave it the support of his public patronage, but entered with spirit and ability into its pursuits, and furnished it with the means of defraying the expense of instruments of the best construction, which were gratuitously distributed to all parts of Europe and even to America. One of the first acts of the Association was to write to all the principal universities, scientific academies, and colleges, soliciting their co-operation and offering to present them with all the necessary instruments properly verified by standards and free of expense. The offer was accepted by thirty societies, and the list of distinguished men who undertook to make the observations shows the importance which was attached to the plan and the zeal with which it was promoted in every part of the Continent. In 1823 the first meeting of the Meteorological Society of London was held, and was attended by Luke Howard, Thomas Forster, Dr. Birkbeck, and others. After 1824 the Society languished, but it was never regularly dissolved. Owing to several letters and articles which appeared in *Loudon's Magazine of Natural History* a meeting was held on November 15, 1836, at which the Society was revived, Mr. W. H. White appointed secretary, and regular meetings resumed. Application was made to the Royal Society for permission to compare the instruments of the Society with the Royal Society's standards, and leave was granted on March 13, 1838. A volume of *Transactions* was published in 1839, and among other articles contains one entitled "Remarks on the Present State of Meteorological Science, by John Ruskin." The cost of the publication of this volume exhausted the funds of the Society, but in 1841 Mr. Gutch undertook personally the pecuniary risk of a new publication entitled the *Quarterly Journal of Meteorology*, but this does not appear to have been very successful, owing to the high rate of postage. Shortly after this the Society practically came to an end. On April 3, 1850, a meeting of some friends of the science was convened by Dr. Lee at Hartwell, when the British Meteorological Society was established, and Mr. S. C. Whitbread elected president. The first general meeting of the Members was not held till March 25, 1851, but in the meanwhile several important steps had been taken by the Council. Annual Reports were published from 1851 to 1861, and since then five volumes of the *Proceedings* and six volumes of the *Quarterly Journal* have been published. Up to 1858 absolutely nothing had been done towards forming a library, but in 1862 a catalogue was published containing about 200 titles. In 1876 a new catalogue was issued, which extends to eighty pages and contains over 1200 entries. On January 27, 1866, the Society obtained a Royal Charter of Incorporation, and has since been known as "The Meteorological Society." On April 4, 1872, the Council resolved upon taking a room for an office and for the protection of the library, and appointed Mr. W. Marriott as their Assistant Secretary. The work has now become so great that the Society has been obliged to take an additional room and to engage three computers. The subsequent eight years have been characterised by great progress. A series of second order stations has been organised which are systematically inspected, and at which strictly comparable observations are made. On January 1, 1880, another and larger series of stations—called climatological—was started, at which the observations are less onerous than those at the second order stations, but at which they are required to be equally accurate. Observations on natural periodical phenomena are also made at many places, and discussed yearly by the Rev. T. A. Preston. At the request of the Society a conference has been appointed consisting of delegates from several other societies to prepare accurate instructions respecting the erection of lightning conductors. At the conclusion of the President's address the following gentlemen were elected the officers and council for the ensuing year, viz.:—President—George James Symons, F.R.S. Vice-presidents: Edward Ernest Dymond, William Ellis, F.R.A.S., Joseph Henry Gilbert, F.R.S., Charles Greaves, M.Inst. C.E., F.G.S. Treasurer: Henry Perigal, F.R.A.S. Trustees: Sir Antonio Brady, F.G.S., Stephen William Silver, F.R.G.S. Secretaries: Robert Henry Scott, F.R.S., John William Tripe, M.D. Foreign Secretary: John Knox Laughton, M.A., F.R.A.S., F.R.G.S. Council: Edmund Douglas Archibald, M.A., Arthur Brewin, F.R.A.S., Henry Storks Eaton, M.A., Rogers Field, B.A., M.Inst. C.E., Frederic Gaster, Baldwin Latham, M.Inst. C.E., F.G.S., Robert John Lecky, F.R.A.S., Edward Mawley, Hon. Francis Albert Rollo Russell, M.A., Richard Strachan, George Mathews Whipple, B.Sc., F.R.A.S., Charles Theodore Williams, M.A., M.D.

Entomological Society, Annual Meeting, January 19.—Sir John Lubbock, Bart., F.R.S., &c., president, in the chair.—The President delivered his annual address, and the following gentlemen were elected as officers for the ensuing year:—President, H. T. Stainton, F.R.S.; Treasurer, E. Saunders, F.L.S.; Librarian, F. Grut, F.L.S.; Secretaries, E. A. Fitch, F.L.S., and W. F. Kirby, F.L.S.; Council, W. Cole, W. L. Distant, M.A.I., F. du Cane Godman, F.L.S., Sir John Lubbock, Bart., F.R.S., &c., R. Meldola, F.R.A.S., O. Salvin, M.A., F.R.S., F. P. Pascoe, F.L.S., R. Trimen, F.L.S.

Victoria (Philosophical) Institute, January 17.—A paper on Pliocene man in America, by Dr. Southall of Virginia, U.S., was read. In it he showed that the evidence brought forward as to the existence of such was wholly unreliable; the same ground was taken in special communications from the Duke of Argyll, K.G., Principal Dawson, F.R.S., of Montreal, Prof. Hughes (Woodwardian Professor of Geology at Cambridge), and Mr. Whitley, C.E., also by Mr. S. R. Pattison, F.G.S.,

and Mr Hall, F.R.G.S., who had examined the evidences on the spot, and by the Rev J M Mello, F.G.S., Mr T. K. Callard, F.G.S., and Mr. E. Charlesworth, F.G.S.—About twenty new Members were elected, bringing the total number to nearly 900.

Institution of Civil Engineers, January 18.—Mr. James Abernethy, F.R.S.E., president, in the chair.—The paper read was on deep winning of coal in South Wales, by Messrs Thomas Forster Brown and George Frederick Adams, MM Inst. C.E. The authors, who were professionally associated with Harris's Navigation Pits, the deepest winning in the district, described the operations as a fair example of the details connected with winning deep coals in South Wales. The depth of the lowest seam at present sunk to was 760 yards, the pits were each seventeen feet in diameter inside the walling. In addition to the depth a special feature was the thickness of hard and heavily-watered rock penetrated. Guide ropes, upon the Galloway principle, were used in sinking, and the value of this system was shown in the saving of over two minutes in steadying the bowk at the bottom of the pit at depths of 475 and 530 yards, the total time occupied in clearance at the latter depth being three minutes twenty-six seconds. The method of dealing with the various feeders of water during sinking was described: one of the pits was drained by a hole bored by the diamond machine, which was put down, at a depth of 175 yards from the surface, for a farther depth of 860 feet.

VIENNA

Imperial Academy of Sciences, January 13.—Dr Fitzinger in the chair.—On the lacunar resorption in diseased bones, by Dr Pommer.—On the physiological significance of the transpiration of plants, by Herr Reinitzer.—On the influence of prussic acid on breathing and circulation, by Dr. Lazarski.—On the relations of homogeneous deformations of solid bodies to surfaces of reaction, by Dr Finger.—Contributions to the photochemistry of silver chloride, by Dr Eder and Herr Pizzighelli.—On a new derivative of gallic acid, by Dr. Oser and Herr Kalmann.—Influence of form of cathode on the distribution of phosphorescence-light (sealed packet of November 17, 1880), by Herr Goldstein.—On a tetra-hydrocinchonin acid, by Dr Weidel.—Determination of magnetic and diamagnetic constants of liquids and gases in absolute measure, by Herr Schulmeister.

January 20.—Herr von Burg in the chair.—Studies on caffein and theobromin (first part), by Prof. Maly and Herr Hinteregger.—Researches on the anatomy, physiology, and development of Sternaspis, by Dr Vejdovsky.—The flight of Libellula, contribution to the anatomy and physiology of organs of flight in insects, by Herr Lendenfeld.—Research on kynurenic acid (first part), by Dr Kretschy.—Action of hydrate cupric oxide on some kinds of sugar, by Prof. Habermann and Herr Honig.

PARIS

Academy of Sciences, January 17.—M Wurtz in the chair.—The following papers were read:—Contemporaneous production of native sulphur in the subsoil of Paris, by M. Daubrée. This sulphur occurs abundantly in the ground of the Place de la République, from 0·2m. to 3m from the surface, and in a space 50m. by 15 to 20m., one finds a breccia with thin incrusted fragments of crystalline sulphur. The product is due to simultaneous presence of the sulphate of lime of plaster-rubbish, and organic *débris*, with which the ancient moat of the centre of the city was filled up two centuries ago.—Order of appearance of the first vessels in the ear of Lolium (second part), by M Trécul.—On the treatment of phylloxerised vines, by M. Marès. He finds very successful an application of dilute sulphocarbonate of potassium to the lower parts of the vines twice a year.—Discoveries in equatorial Africa, meeting of MM de Brazza and Stanley, by MM de Lesseps and de Quatrefages. M de Brazza speaks of having descended the Congo and founded the station of Ntamo Ncouna, twelve marches from Ogôoué, it is the most advanced post in the heart of Africa, and will be an important centre for exploration, &c. He had met Stanley on November 7 near Vivi. Capt. Bloyet has established a station near Lake Touquerko.—Observations of the comet *f* 1880 (Pechulé) at Paris Observatory, by M Bigourdan.—On the displacement of an invariable figure, by M Darboux.—Integration in finite form of a new species of differential linear equations with variable coefficients, by M. André.—On the theory of vibrating plates, by M. Mathieu.—On complete combinations; number of complete combinations of *m* letters *n* to *n*, by M Melon.—Remarks on an opinion attributed to me by a note of M Cornu, by M. Gouy.—Minimum of the power of resolution of a prism, by M Thollon.—On the production of intermittent luminous signals with the electric light, by M. Mercadier. One carbon is horizontal, and advances a little at each signal. The other is vertical, and is held in a peculiar clip at one end of a horizontal lever, to the other end of which is fixed a vertical rod with terminal friction roller working on a cam. The vertical carbon is connected with the battery by a wire spring, and it is dropped a little by the clip at certain positions of the cam. The cam may be turned by clockwork for regular signals, or with the hand, at a variable rate, for irregular.—Observations *à propos* of M. Dunand's recent paper on reproducing speech with electric condensers, by M. Herz. He patented the use of a condenser as telephonic receiver on M Dunand's principle in June last year.—Some facts to serve in the history of nitrification, by MM. Hautefeuille and Chappuis. Electric effluves, intense enough to quickly give much ozone in a mixture of oxygen and nitrogen, but not to form hyponitric acid, produce the new unstable pernitric acid. Using lower tensions, the formation of this acid is found to go side by side with that of ozone. Pernitric acid is decomposed at all temperatures, but at 130° the decomposition is complete in a few seconds (into hyponitric acid and oxygen). Numerous experiments seem to prove that in simultaneous production of ozone and pernitric acid by the effluve the gases have not been raised to a temperature near that named, where hyponitric acid is formed, that temperature has been passed. A consequence of the facts is that effluves corresponding to weak tensions may furnish nitric acid, ultimate product of decomposition of pernitric acid.—On the conservation of grain in reservoirs (continued), by M Muntz. Oats kept in a ventilated granary thirty months had lost 7·2 per cent more of fixed matter (chiefly starch) than oats kept the same time in a metallic reservoir (of 220 cubic m capacity), having its lower part in a subsoil. In the sub-reservoirs there is a distillation towards the upper part. To get all the advantage of closed reservoirs there should be a comparatively dry grain, a perfect closure, and a maintenance of the walls at pretty constant temperature.—Study of the peat of crystalline strata of Finistère, by M. de Molon.—On the parts of the pancreas capable of acting as ferments, by M Bechamp. All the known properties of the pancreas are concentrated in the microzymas.—Anatomical researches on the digestive, nervous, and reproductive apparatus of Onchidia, by M. Joyeux Laffine.—Hypertrophy and multiplication of nuclei in hypertrophied cells of plants, by M. Prillieux.—On the production of *verglas*, by M Minary. He thinks the theory needs correction. Instead of regarding water in a state of surfusion as composed only of liquid, he supposes it formed of a mixture of liquid and of solid molecules (of ice) held apart by some unknown cause. For the congelation to be complete when surfusion ceases, the ice of the mixture merely requires (in order to rise to 0°) a quantity of heat equal to the latent heat still conserved by the quantity of water in surfusion.

CONTENTS

THURSDAY, FEBRUARY 3, 1881

PREHISTORIC EUROPE

Prehistoric Europe A Geological Sketch By James Geikie, LL D., F.R S. 8vo (London. Stanford, 1881)

Les Premiers Hommes et les Temps Préhistoriques Par le Marquis de Nadaillac. Two vols. 8vo (Paris Masson, 1881)

THE condition of Europe outside the reach of history and the changes by which it has come to be what it is, the appearance of man and his progress in culture, combine to form a subject which cannot, in our opinion, be treated satisfactorily in the present state of knowledge New facts are being daily brought to light, the speculations of yesterday are being tested by the discoveries of to-day, and the accumulation of materials necessary to form a sound judgment even in any one department, such, for instance, as archæology, is so great, that it may well daunt the courage of the boldest writer who knows the nature of the task before him In the two books before us the subject is treated from totally different points of view Dr James Geikie takes his stand upon the glaciated mountains of Scotland, and attempts to throw the glacial net woven in his previous work, "The Ice Age," over the whole of Europe, and the Marquis de Nadaillac records the facts which he has collected from various quarters, America included, in what may be called a prehistoric gazetteer. The one avowedly takes up the position of an advocate, and pushes glacialism and interglacialism to an extreme, while the other takes the safer, though humbler, ground of a man who has no original views to put forward The works of both will be useful exactly in proportion to the knowledge and judgment of the reader. There is wheat in both works, but it needs a careful winnowing, as we shall proceed to show

In his previous work Dr James Geikie proposed a classification of the Pleistocene deposits of Europe based mainly on observations which he has made in certain parts of Scotland, and attempted a more minute subdivision of the glacial strata than the threefold arrangement generally recognised by European geologists He advocated a complicated series of arctic glacial and of warm interglacial periods, layers of clay with boulders representing the one, and strata of sand, gravel, loam, or peat the other. His views are by no means accepted, even for Scotland, and the small progress made in general classification during the last twenty years may be estimated from the fact, that scarcely any two geologists agree in correlating the clays and sands on the east and west side of the Pennine Chain with one another and with the glacial strata of Wales, Cumbria, or Scotland There also is a considerable difference of opinion as to the clays themselves having been derived from glaciers or from icebergs. In his present work he treats these difficulties as solved, and devotes one large section to show "English geologists" (why English?) that all the fluviatile and cave-accumulations with Palæolithic man and the Pleistocene mammalia usually termed Post-glacial, are "of Interglacial, and not of Post-glacial date" The latter term is here used in the sense of being "later than the last great extension of glacier ice in Europe," while the former represents the interval of time between the retreat of one set of glaciers and the advance of another, or that between the deposits of one set of icebergs and those of another. Lyell, Prestwich, Evans, Hughes, and the great majority of those who have worked at the subject hold that the Pleistocene mammalia invaded Europe before the glacial cold had set in, and swung to and fro according to the fluctuations of temperature while the glaciers were advancing and retreating, and that there is proof that Palæolithic man and the extinct animals were in Britain "after the last great extension of the glaciers" (if they were glaciers and not icebergs) We will then appeal to the facts which have been repeatedly urged in the *Proceedings* of the Geological Society and of the Anthropological Institute, as well as in most of the separate works published in Britain since the year 1860

The area over which Palæolithic implements and Pleistocene mammalia occur in direct relation to the glacial deposits is principally the valley of the Thames and of the Severn, and the Midland and Eastern counties In the first of these they occur in fluviatile strata, such, for example, as the gravels on which London stands, which are composed of materials derived from the destruction of "the chalky boulder clay" In the valley of the Severn the Pleistocene mammalia are imbedded also in the *detritus* of the boulder clay of that region (Lucy) In the neighbourhood of Cambridge (Hughes, Fisher) the same is the case In the neighbourhood of Bedford, Wyatt, Prestwich, and Lyell pointed out long ago, not only that the gravels containing the flint implements and fossil mammals were composed of materials that resulted from the wreck of the boulder clay, but that the deposit rested in a hollow which had been cut through "the great chalky boulder clay" of the district. At Hoxne the mammaliferous gravels with Palæolithic implements rest on that boulder clay The clays in question are the only signs of the extension of glaciers (? icebergs) over those districts, and the fluviatile deposits are obviously of later date This conclusion Dr James Geikie does not venture to dispute, but he asks us to believe that formerly another sheet of boulder clay has covered up all these deposits, and that it has been removed so completely that no trace of it is now to be seen He fixes his attention on the purple clay and the Hessle clay, which occupy an exceedingly limited area, in Yorkshire and Lincolnshire, and imagines that they represent glacial periods, one of which, not specified, extended over the fluviatile strata in question, and caused these strata to be inter- instead of post-glacial These boulder clays are local and unimportant, and have not been met with over any deposit containing Palæolithic implements In advancing this speculation he is drawing a cheque on our credulity which is not likely to be honoured The strata in question are proved by their position to be later than the glacial deposits of the districts in which they occur, it is for him to prove that they are earlier than glacial deposits elsewhere. This he has not done Still less can his conclusion be accepted that Palæolithic man and the Pleistocene beasts associated with him are solely "interglacial" in Britain and on the Continent in non-glaciated areas The cases quoted above, and they might be greatly increased, prove that man and the Pleistocene beasts were

in Europe "after the last great extension of glaciers"—or in the Post-glacial times.

There is also reason to believe that man was living in Europe before and during the Glacial period, or, in other words, in Pre-glacial, Glacial, and Inter-glacial times, although the alleged discovery of man in the Victoria Cave, relied upon by Dr J Geikie, has been shown to have been founded on a mistake, and the inter-glacial age of the implements at Brandon and Thetford, which he quotes as being of great importance, is not accepted by very good judges such as Dr Evans and Prof. Hughes These however may be dismissed as throwing no light on the question as to the existence of man in Britain after the great extension of the glaciers.

Dr J Geikie's method of arriving at the climate of his "Inter-glacial periods" is equally faulty He considers that they were warm and genial, because of the presence of certain land shells, such as *Cyrena fluminalis*, the climatic value of which is at present unknown, of certain marine shells, the distribution of which is dependent on the warm and cold currents, and of land-mammalia now found only in southern latitudes, such as the hippopotamus, the limit of whose endurance of cold is yet to be proved, since those in the Zoological Gardens in London will take their tubs in frosty weather But, unfortunately for his argument, the last animal is associated with arctic species, such as the reindeer, in all the caves (Kirkdale, Durdham Down, &c) except two, and in all the river deposits (Bedford, Acton, &c) except some three or four, in which it has been found in this country. With equal reason we might argue that the climate was arctic from the presence of reindeer The consideration which he urges, that the two groups of animals could not live side by side because they do not live now, is met by the direct testimony of their associated remains, not merely in this country but on the continent. The hyænas, for example, of Kirkdale and of the Vale of Clwyd ate reindeer and hippopotamuses, and dragged them into their dens, where their gnawed fragments occurred in one and the same stratum We may remark that in dealing with the fauna of the Victoria Cave Dr J Geikie omits all notice of the reindeer, the presence of which destroys his argument as to climate. This selection may be taken as a fair sample of the mode in which he has dealt with the whole evidence offered by the Pleistocene mammalia He deals with it, not with the impartiality of a judge, but as an advocate, and has only called those witnesses which count on his side The vast numbers of reindeer associated with the remains of Palæolithic man from the caves of Cresswell as far as the Alps, and from the Pyrenees into the valley of the Danube, prove that the climate in those regions was in those times not "a warm inter-glacial" climate, but one in harmony with hat indicated by the blocks of stone in the gravels pointed out by Prof Prestwich

The interglacial net is spread far and wide over the Continent. It includes not merely the forest with fig-trees and Judas-trees and laurestinas of Moret, which, as Saporta points out, would have been killed off by a spell of hard frosts, to say nothing of such a climate as is implied by the supposed preceding Glacial period, of which there is no evidence in that locality. It covers the deposits of Mont Perrier, near Issoire, from which MM. Croizet and Jobert obtained a rich fauna, universally considered typical upper Pleiocene. It covers also the mammaliferous deposit of Liffe, near Gandino in the Italian Alps, in which the mammalia identified by Forsyth Major are unmistakably Pleiocene. It is even stretched so as to take in the so called Pleiocene man of Olmo, near Arezzo, the age of which, as Dr. Evans has pointed out, is proved to be Neolithic by the associated implements. Thus we have things of widely different and of well-ascertained age grouped together under the head of "inter-glacial," and we have in this fact proof that the classification is so far worthless, as indeed every system must be which is based on ice, and ice only.

In further illustration of this we may quote the view of our author, that in the period usually termed Prehistoric, or recent, but by him "Post-glacial," Europe was connected by land with the Faroes, Iceland, and Greenland, and that the climate was genial It is assumed that the "last glacial period" killed off all the Pleistocene forests in those latitudes, and that the present traces of forests are the result of subsequent growths, extending from one point to all the rest along a continuous tract of land If we allow this, surely in the far north, to say the least, they are "interglacial," seeing that they are wedged in between "the last Glacial period" and the present glacial conditions. But we can allow neither his assumption nor can we accept his geography The Post-glacial glaciers of Scotland spoken of on p 526 seem to us proof that the ice-classification breaks down, and the admission that the Great Ice age is merely "a stage or phase of the Pleistocene period" is a frank confession tending in that direction

It is only necessary to say a few words about the two large volumes of the Marquis de Nadaillac His attitude of reserve with regard to Meiocene and Pleiocene man is judicial and impartial But we would point out that here and there in the work serious errors are to be remarked He considers, for example, the Archæopteryx a tertiary bird, he associates the Liassic fish of Lyme Regis with the "Tertiary fishes of Lebanon and Monte Bolca," and he writes of the Ichthyosaurus and Plesiosaurus as if they belonged to the Eocene age

In neither of these works can we find any addition to what has been already known about Prehistoric Europe, and in both there are omissions of well-known facts which it is impossible to notice within the limits of these columns. W. BOYD DAWKINS

THE BIOLOGY OF PLANTS

Beiträge zur Biologie der Pflanzen. Herausgegeben von Dr Ferdinand Cohn Vol. ii part 3, with 5 plates; vol iii. parts 1 and 2, with 15 plates · (Breslau: J U Kern, 1877, 1879, and 1880)

IN the concluding part of the second volume of the well-known *Beiträge* three out of four papers are devoted to fungi and Bacteria, one only being physiological. This physiological paper is by Dr. Just, on the action of high temperatures upon the preservation and germination of seeds. The experiments, which are described in minute detail, were made with Nobbe's germinating apparatus and a thermostat. Horstmann's thermostat, which was the one employed for all tempera-

tures up to 60° C., is described and figured at p. 348, and consists essentially of a closed vessel with triple walls, the space between the inner and middle plate filled with water, the outer containing air. For higher temperatures a simple tin plate thermostat was employed, the space being filled with water for temperatures up to 100° Cent. and with glycerine or oil for higher temperatures. The source of heat was always a gas-flame with the usual thermo-regulator. Numerous tabulated results are given of experiments upon moist and dry seeds at various temperatures, and it was found, as might be anticipated, that perfectly dry seeds can withstand a high temperature, even between 120° and 125° Cent., without injury

Dr. Koch describes how bacteria can be observed, prepared, and photographed, this paper forming the sixth of the extremely important series of researches on bacteria which have from time to time appeared in the *Beiträge*. A thin layer of bacteria with the fluid containing them is to be dried on a thin cover of glass By placing the glass cover with the dried material in absolute alcohol, or better, in a 0·5 per cent. solution of chromic acid, the bacteria are fixed to the cover, although the coagulated ground substance in which the bacteria are imbedded can be made to swell up and the bacteria themselves to resume their natural forms when the cover is placed in a solution of acetate of potash (1 part to 2 of distilled water) The bacteria can be coloured by means of aniline, the best of all being aniline brown, but methyl violet and fuchsin will also answer. The stained object can be preserved permanently on slides by mounting in Canada balsam, concentrated solution of acetate of potash, or in glycerine Twenty-four photographs of bacteria, mostly from specimens stained with aniline brown, illustrate the paper, and in some, as 5 and 6 on Plate XIV., the cilia of bacillus are very beautifully shown, magnified 500 and 700 diameters Koch finds that it is easier to photograph the cilia than to observe them directly with the microscope

The other papers in this part are on certain Ustilaginæ, by Dr Schroeter, and on two new species of Entomophthora (*E conglomerata* and *E. ramosa*) discovered upon dead gnats, by Prof N Sorokin

The first and second parts of vol. iii. contain eleven papers. Four of these are devoted to Bacteria, and form the seventh to the tenth of the series of Researches on Bacteria already alluded to. The titles of the papers are VII Experiments on Infection with *Micrococcus prodigiosus*, by Dr A. Wernich; VIII. Researches on the Bacteria in Air, by Dr. Miflet, IX. On the Action of the Electrical Current on the Multiplication of Bacteria, by Dr. F Cohn and Dr Mendelssohn, and X. Studies of Blue Milk, by Dr F Neelsen. Two of these papers may be briefly mentioned. By means of a specially contrived apparatus fitted with a new continuous aspirator, the invention of Paul Boehme in Brunn, atmospheric air from different localities was examined. These were (1) air in Botanical Laboratory; (2) in Fever Hospital; (3) in the Pathological Theatre, (4) in the Surgical Theatre; (5) air in Botanic Garden, (6) air for soil, and (7) air for drains. The results were briefly as follows:—1. Germs of bacteria capable of developing are abundant in the air, and could readily be collected and cultivated in a special mineral solution, malt extract, or solution of Liebig's extract of beef. 2. Many forms of bacteria can produce reproductive germs in air, while others, as *B Termo*, seem only capable of producing germs in putrescent matter. 3 Air from the soil contained occasionally germs of bacteria 4. Air from the Fever Hospital contained no germs, owing to the completeness of the ventilation and disinfection. 5 Air from a sewer contained abundance of germs of bacteria capable of reproducing.

Neelsen, in his paper on Blue Milk, finds that the special organism in it may assume three or four different forms, sometimes like Bacterium, then like Bacillus, then like a Chroococcus, and lastly like a Leptothrix. He discusses the Theory of Cohn and others that the Bacteria form many separate genera and species, and the Theory of Lankester and Warming, that they are forms of a protean species, and seems to conclude that the germs of a given form may under different conditions develop in one or other direction, as observed by him in blue milk

Dr Schroeter continues his observations on the Development of Rust, and Dr Oscar Kirchner describes the Development of *Volvox minor*, Stein. Dr. Hielsher describes the Anatomy and Biology of the Genus Streptocarpus, and details many interesting facts regarding that curious and beautiful genus When the seed of *Streptocarpus polyanthus* germinates, numerous adventitious roots form on the primary axis, one of the two cotyledons soon disappears, while the other develops greatly, and forms a perennial foliage leaf. On the petiole of this leaf numerous adventitious roots develop and the primary axis disappears The leaf produces adventitious buds from which the flowers develop, while it also develops a series of adventitious leaf-buds. Dr Beinling contributes a paper on the formation of adventitious roots and buds on the leaf-cuttings of Peperomia Prof Klein describes in detail the anatomy of *Pinguicula alpina* as an insectivorous plant, and points out that the plant occurs in two forms, one with green leaves, the other with the leaves more or less red-brown in colour, and that the tissues assume an intense yellow colour when acted on with caustic potash solution The remaining papers are by Dr. Schwartz, Chemico-botanical Studies on the Acids in Lichens, and Dr Eidam on the Gymnoasci. The various papers ably sustain the reputation of this work, and all of them will well repay careful study

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts No notice is taken of anonymous communications.*

The Editor urgently requests correspondents to keep their letters as short as possible The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Dust and Fogs

I MUCH regret the Hon. R. Russell, in his letter to NATURE, vol. xxiii. p 267, takes such an extremely desponding view of the influence which my experiments on cloudy condensation are likely to exercise upon the present attempts to rid the atmosphere of our large towns of their ever-recurring fogs. The object of these experiments was to find out what caused fogs, in the hope that with the knowledge thus acquired we might be better able to find a remedy. The preferable course seemed to be to find the cause first, and then if possible devise some remedy, rather than try remedies at haphazard.

It is certainly very far from my desire to discourage the present attempts which are being made to clear the atmosphere of our large towns of smoke, and I have recognised the advantages which would result from the adoption of more perfect forms of combustion. In my paper I have simply distinguished between fogs and smoke, and separated them for distinct consideration and treatment, and have at the same time directed attention to some points which ought to be considered before deciding on their prevention

With regard to Mr Russell's difficulty in reconciling the result of the experiments with what is observed with regard to fogs in London, Paris, and other large towns, it appears to me to have arisen entirely from not putting sufficient weight on the all important influence of the amount of vapour in the air of the different places. It is condensed vapour which forms the fog, and dust simply determines whether it will condense in fine- or coarse-grained particles The atmosphere of Paris, compared with that of London, is an extremely dry one, and the air is seldom in a condition to produce fogs. The atmospheres of the other towns mentioned are also drier, some of them very much drier, than that of London. London however will probably be always more subject to fogs than other cities on account of its great size, some part of it being always in its own smoke.

Considered from a different point of view, might not the fog of January 31, 1880, referred to by your correspondent, be cited in evidence of a conclusion the opposite of that drawn by the writer, and in favour of the correctness of the experimental results? From this point of view the low white fog cleared away because it was formed in the comparatively pure air of the streets, while the higher fog did not clear away because it was formed in the products of combustion The true explanation however would rather appear to be, that where the fog was white it was also of less depth than in those places where it "extended high" and mixed with the smoke; and the sun, which was only sufficient to dispel the lesser depth "more or less," would evidently be insufficient to clear away the greater depth. It is however impossible to form any definite idea as to how this particular fog conducted itself, without much fuller information as to air-current, &c

I have communicated to the secretary of the Royal Society of Edinburgh a second experimental paper on fogs, with special reference to dry fogs In this paper the full answer to the latter part of Mr. Russell's letter will be found JOHN AITKEN

Darroch, Falkirk, January 24

Professors Exner and Young

MY statement in respect to Prof. Exner's having announced the thermo electric neutrality of a bismuth-antimony pair immersed in pure nitrogen, rested upon a note in NATURE (vol. xxii p 156), and this it seems was based upon a statement in *L'Electricité* I have seen those of Prof Exner's papers which have appeared in the *Annalen der Physik*, and there is certainly nothing of the sort in *them*, but I supposed that it must be contained in some other paper in some one of the numerous other publications to which I have not access here. It never occurred to me, until within a very short time, that there could be any mistake as to his having made such an assertion. How or where the error originated I cannot quite understand, but I trust Prof. Exner will accept my apologies for my share in its propagation, and that he and all concerned will be satisfied that no misrepresentation was intended on my part. The incident is a good illustration of the extreme care necessary in commenting upon the views of another person C A YOUNG

Princeton, U.S.A., January 12

The Flying-fish

IT is remarkable that there should still be any doubt as to the facts in connection with the flight of the flying-fish. Dr. Gunther ("Study of Fishes," p. 622), summarising the observation of Möbius, says that "they frequently overtop each wave, being carried over it by the pressure of the disturbed air" (*in the open sea!*). Again, flying-fishes "never" fall on board vessels "during a calm or from the lee side." At night "when they are unable to see they frequently fly against the weather-board, when they are caught by the current of air and carried upwards to a height of twenty feet above the surface of the water." Surely the fish going at the rate of at least ten miles an hour would on striking the "weather-board" be dashed, bruised and helpless, back into the water instead of coming over the side fresh and vigorous, flapping about on the deck. Except when "by a stroke of its tail" it turns towards the right or left, Mobius concludes that "any deflection from a straight course is due to external circumstances, and not to voluntary action on the part of the fish."

I have watched flying-fish repeatedly, and have invariably seen them fly, or rather glide, over the surface of the sea, and from one to two feet above it, rising gently to the swell when there was no wind, and occasionally turning to the right or left without touching the water I do not say that when there is a breeze the tail of the fish may not touch it, but I think that, with the foam and spray of the broken water, it would be very difficult to be sure of it, and, moreover, if the tail was used the motion would be a jerking one. Mr. Wallace speaks of their "rising and falling in the most graceful manner," which, although he is referring to another species, applies also to the North Atlantic form (*Exocœtus evolans*) Mr. Bennett ("Gatherings," &c, p. 14) says that they "spring from the sea to a great elevation" This is probably in reference to their coming on board ship at night, attracted, it is supposed, by the lights. I believe the pectoral fins are kept extended without any motion, except perhaps as Mr. Whitman,[1] a recent observer, says, just when they rise from the sea. He gives 800 to 1200 feet as the greatest distance he has seen them fly, and about forty seconds as the longest time out of the water By what mechanical means they move when out of the water is still to me a mystery.

I have never known the flying-fish to be pursued by other fish, nor ever seen any bird near them, indeed few birds are ever seen far from the land north of the southern tropic, where flying-fish are most abundant. The dolphin (*Coryphæna*) is supposed to be their greatest enemy. I had once an opportunity of seeing one opened—in the West Indies—its stomach was quite full of *Orthagoriscus mola*, very young, being not quite an inch long

FRANCIS P PASCOE

1, Burlington Road, W, January 21

Mr S. Butler's "Unconscious Memory"

I MUST reply to the review of my book, "Unconscious Memory," in your issue of the 27th inst., and to Dr. Krause's letter on the same subject in the same issue

Mr Romanes accuses me of having made "a vile and abusive attack upon the personal character of a man in the position of Mr. Darwin," which I suppose is Mr Romanes' way of saying that I have made a vile and abusive personal attack on Mr Darwin himself. It is true I have attacked Mr. Darwin, but Mr. Romanes has done nothing to show that I was not warranted in doing so I said that Mr Darwin's most important predecessors as writers upon evolution were Buffon, Dr Erasmus Darwin, Lamarck, and the author of the "Vestiges of Creation." In the first edition of the "Origin of Species" Mr. Darwin did not allude to Buffon nor to Dr. Erasmus Darwin, he hardly mentioned Lamarck, and he ignored the author of the "Vestiges" except in one sentence. This sentence was so gross a misrepresentation that it was expunged—silently—in later editions. Mr. Romanes does not and cannot deny any part of this

I said Mr Darwin tacitly claimed to be the originator of the theory of evolution, which he so mixed up with the theory of "Natural Selection" as to mislead his readers Mr. Romanes will not gainsay this. Here is the opening sentence of the "Origin of Species":—

"When on board H.M.S. *Beagle* as naturalist, I was much struck with certain facts in the distribution of the inhabitants of South America, and in the geological relations of the present to the past inhabitants of that continent These facts, as will be seen in the latter chapters of this volume, seemed to throw some light on the origin of species, that mystery of mysteries, as it has been termed by one of our greatest philosophers. On my return home it occurred to me in 1837 that something might perhaps be made out on this question by patiently accumulating and reflecting upon all sorts of facts which could possibly have any bearing on it. After five years' work I allowed myself to speculate upon the subject, and drew up some short notes; these I enlarged in 1844 into a sketch of the conclusions which then seemed to me probable, from that period to the present day I have steadily pursued the same object. I hope that I may be

[1] See *Zoologist* for November, 1880

excused for entering upon these personal details, as I give them to show that I have not been hasty in coming to a conclusion"—"Origin of Species," p. 1, ed. 1859.

What could more completely throw us off the scent of the earlier evolutionists, or more distinctly imply that the whole theory of evolution that follows was an original growth in Mr. Darwin's own mind?

Mr. Romanes implies that I imagine Mr. Darwin to have "entered into a foul conspiracy with Dr. Krause, the editor of *Kosmos*," as against my book "Evolution, Old and New," and later on he supposes me to believe that I have discovered what he calls, in a style of English peculiar to our leading scientists, an "erroneous conspiracy" The idea of any conspiracy at all never entered my mind, and there is not a word in "Unconscious Memory" which will warrant Mr. Romanes' imputation. A man may make a cat's paw of another without entering into a conspiracy with him

Later on Mr. Romanes says that I published "Evolution, Old and New," "in the hope of gaining some notoriety by deserving, and perhaps receiving, a contemptuous refutation" from Mr Darwin I will not characterise this accusation in the terms which it merits

I turn now to Dr Krause's letter, and take its paragraphs in order

1 Dr Krause implies that the knowledge of what I was doing could have had nothing to do with Mr Darwin's desire to bring out a translation of his (Dr Krause's) essay, inasmuch as Mr Darwin informed him of his desire to have the essay translated "more than two months prior to the publication of" my book, "Evolution, Old and New" This, I have no doubt, is true, but it does not make against the assumption which I made in "Unconscious Memory," for "Evolution, Old and New," was *announced* fully ten weeks before it was published. It was first announced on February 22, 1879, as about to contain "copious extracts" from the works of Dr Erasmus Darwin and a comparison of his theory with that of his grandson, Mr. Charles Darwin. This announcement would show Mr Darwin very plainly what my book was likely to contain, but Dr Krause does not say that Mr Darwin wrote to him before February 22, 1879—presumably because he cannot do so. I assumed that Mr. Darwin wrote somewhere about March 1, which would still be "more than two months before" the publication of "Evolution, Old and New."

2 Dr Krause says I assume that "Mr Darwin had urged him to insert an underhand attack upon him (Mr. Butler)" I did not assume this; I did not believe it, I have not said anything that can be construed to this effect I said that Dr Krause's concluding sentence was an attack upon me, Dr Krause admits this I said that under the circumstances of Mr Darwin's preface (which distinctly precluded the reader from believing that it could be meant for me) the attack was not an open, but a covert one; that it was spurious—not what through Mr. Darwin's preface it professed to be, that it was antedated, that it was therefore a spurious and covert attack upon an opponent interpolated into a revised edition, the revision of which had been concealed. This was what I said, but it is what neither Mr Romanes nor Dr. Krause venture to deny I neither thought nor implied that Mr Darwin asked Dr Krause to write the attack. This would not be at all in Mr. Darwin's manner

3. Dr Krause does not deny that he had my book before him when he was amending his article He admits having taken a passage from it without acknowledgment. He calls a page and a half "a remark," I call it "a passage." He says he did not take a second passage I did not say he had; I only said the second passage was "presumably" taken from my book, whereas the first "certainly" was so The presumption was strong, for the passage in question was not in Dr Krause's original article; it was in my book, which Dr Krause admits to have had before him when amending his article, and it came out in the amended article; but if Dr Krause says it is merely a coincidence, of course there is an end of the matter

4. Dr. Krause, taking up the cudgels for Mr Darwin, does not indeed deny the allegations I have made as to the covertness, and spuriousness, and antedating of the attack upon myself, but contends that "this is not due to design, but is simply the result of an oversight"; he is good enough to add that this oversight "could only be most agreeable" to myself. When I am not in the wrong I prefer my friends to keep as closely as they can to the facts, and to leave it to me to judge whether a modification of them would be "most agreeable" to me or no. What, I wonder, does Dr Krause mean by oversight? Does he mean that Mr. Darwin did not know the conclusion of Dr. Krause's essay to be an attack upon myself? Dr Krause says, "To every reader posted up in the subject this could not be doubtful," meaning, I suppose, that no one could doubt that I was the person aimed at. Does he mean to say Mr Darwin did not know he was giving a revised article as an unrevised one? Does he mean that Mr Darwin did not know he was saying what was not true when he said that my book appeared subsequently to what he was then giving to the public? Does he pretend that Mr Darwin's case was not made apparently better and mine worse by the supposed oversight? If the contention of oversight is possible, surely Mr Darwin would make it himself, and surely also he would have made it earlier? Granting for a moment that an author of Mr Darwin's experience could be guilty of such an oversight, why did he not when it was first pointed out, more than twelve months since, take one of the many and easy means at his disposal of repairing in public the injury he had publicly inflicted? If he had done this he would have heard no more about the matter from me. As it was, he evaded my *gravamen*, and the only step he even proposed to take was made contingent upon a reprint of his book being called for. As a matter of fact a reprint has not been called for Mr Darwin's only excuse for what he had done, in his letter to myself, was that it was "so common a practice" for an author to take an opportunity of revising his work that "it never occurred" to him to state that Dr Krause's article had been modified. It is doubtless a common practice for authors to revise their work, but it is not common when an attack upon an opponent is known to have been interpolated into a revised edition the revision of which is concealed, to state with every circumstance of distinctness that the attack was published prior to the work which it attacked

To conclude I suppose Mr Romanes will maintain me to be so unimportant a person that Mr Darwin has no call to bear in mind the first principles of fair play where I am concerned, just as we need keep no faith with the lower animals. If Mr Darwin chooses to take this ground, and does not mind going on selling a book which contains a grave inaccuracy, advantageous to himself and prejudicial to another writer, without taking any steps to correct it, he is welcome to do so as far as I am concerned—he hurts himself more than he hurts me. But there is another aspect of the matter to which I am less indifferent: I refer to its bearing upon the standard of good faith and gentlemanly conduct which should prevail among Englishmen—and perhaps among Germans too I maintain that Mr Darwin's recent action and that of those who, like Mr. Romanes, defend it, has a lowering effect upon this standard S BUTLER

Geological Climates

WHEN a reader of the intelligence of Mr Wallace misunderstands my words it becomes plain to me they have failed to convey my meaning. I do not accept the interpretation he has put upon them, nor do I admit that even that interpretation would tell so much in favour of his theory as he supposes

As however I agree with him that the question is far too large to be fully discussed in your columns, I shall allow the controversy, so far as I am concerned, to terminate, and shall publish my detailed views on geological climate in another way SAMUEL HAUGHTON

Trinity College, Dublin, January 27

On the Spectrum of Carbon

IN the discussions on the spectrum of carbon which have recently appeared in your journal much stress is laid on the impossibility of volatilising that substance by any heat which man can produce I think this assumption is not warranted by experience Two or three facts in Despretz' account of a remarkable set of experiments which he made about thirty years ago, seem to me to show it to be unfounded This is given in the *Comptes rendus*, vol xxviii He exposed rods of anthracite to the action of 125 Bunsens (zincs $5\frac{1}{4}$ in high) and also to the solar focus of an annular lens 36 in diameter. The rods bent under the combined action, and even appeared to fuse! In vol. xxix he describes experiments with rods of sugar charcoal under a battery of 500 similar cells The electric egg was covered suddenly with a hard black crystalline powder.

He thinks attempts to fuse carbon should be made in condensed nitrogen and in metallic vessels In the same volume he says that with 600 cells rods of sugar charcoal bend—swell at the

ends—and when they touch, weld together, and their surfaces become metallic, like graphite.

Diamonds heated in charcoal tubes were suddenly changed and became conductors. Still more remarkable effects were produced when he used collaterally with the 600 Bunsens 135 Munckè with zincs 13¾ in high and 19½ in. wide With these sugar-charcoal was volatilised immediately.

I think it may be inferred from these facts that even at the temperature of a powerful electric arc enough charcoal vapour may be present to form its spectrum, and there is little doubt that the temperature of discharge of a good inductorium combined with a sufficient condenser is still hotter than the arc.

It is to be noticed that Despretz in these experiments anticipated Dr. Siemens's electric furnace. He mentions that he fused 3750 grains of platinum in a few minutes, and could have done more had he had a larger crucible. R

A Case of Fascination

SOME years ago it was my fortune to witness a case of "fascination" between a large striped snake and a medium-sized toad. When first seen they were about fifteen inches apart. The snake lay in a coil with its head thrust out towards its victim, and moving slowly, its eyes glittering and its tongue darting incessantly.

The toad was standing on the very tips of its claws, with its limbs rigidly drawn up to their full length, its eyes fixed upon its captor and fairly bursting from their sockets, its mouth covered with foam, and its whole body swaying to and fro, and seeming just ready to pitch forward upon its face

The movement of the snake became more and more rapid, and the agitation of the toad more intense, until the space between them was reduced to some three or four inches, when the snake opened wide its mouth, and the laboured breathing of its victim stopped short in a low guttural moan

At this point my own agitation became so great that, seizing a heavy stone, I finished the snake at one blow. The instant the snake was struck the toad fell backward as suddenly as though itself had been hit, and lay upon its back for some minutes with no signs of life At length it gained its feet and began to creep languidly away J. T BROWNELL

Lyons, N Y., January 18

Birds Laying in January

As a proof of the unusual mildness of the weather just previous to the intense frost and severe snowstorms most parts of the country have lately been suffering from, it may interest some of your readers to learn that not far from this place, on the 13th Jan, a wren's nest with seven eggs in it, quite fresh, was taken. The nest I have in my possession, and it bears every evidence of having been lately tenanted. The eggs, I am sorry to say, are broken, they were placed in a cup for safety, and were most unfortunately knocked down when the room was dusted, giving however unmistakable proof of their having been but lately laid

I do not know whether there is any instance on record of a wren's nest having been found in January before.

JOHN H WILLMORE

Queenwood College, near Stockbridge, Hants, January 28

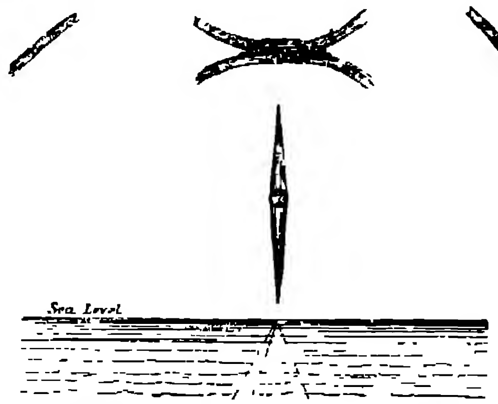
Vibration of Telegraph Wires during Frost

WHILE walking with my son by the Liverpool, Crosby, and Southport Railway between Crosby and Hall Road stations he called my attention to the telegraph wires, which were in a state of rapid vibration The day was frosty, the time 11.30 a m., and the sun, which had been showing us a bright disk through the haze, was beginning to throw out rays and shine a little strongly. At first I thought the movement must be only apparent —a mere optical delusion—as the air was perfectly calm. A closer examination convinced me to the contrary, as the under part of the wires were covered with pendant ice needles, a sort of rime, which moved to and fro indicating a torsional or twisting vibration of the wires, and as the rapidity of the vibrations decreased this was more clearly seen. In about five minutes the movement ceased, and I have not noticed it since, though I have frequently passed under the wires on my way to skate. Can any of your correspondents account for the phenomenon? It appeared as if in some way connected with previous contraction by the frost and sudden expansion in jerks by the sun's rays My son informs me that two years ago, during a frost, he noticed the strained wires of a garden-fence behaving in the same curious way.

Park Corner, Blundellsands T. MELLARD READE

"Mock Sun"

I SEND a sketch of a parhelion which I saw from the East Cliff, Hastings, on Thursday, January 20, at 3 p.m. The crescents above the sun were fairly bright and well developed, and there were faint traces of a *second* ring outside, and some distance from, the first.



There was a slight fog at the time, with a north-east wind and *hard frost*, which has continued up to this time We have had no snow here since that "terrible Tuesday," the 18th.

I do not remember ever having seen this phenomenon before, except in pictures of the Arctic Regions.

St Leonards, January 24 J E H. PEYTON

ON SOME RECENT CHARTS AND MAPS OF CURVES OF EQUAL MAGNETIC VARIATION OR DECLINATION

SINCE the year 1701, when Halley published his famous chart showing curves of equal magnetic variation for the Atlantic and Indian Oceans, the construction of similar charts, amended and enlarged as data increased, has been of great interest to magnetic science and of practical value to the navigator

Halley's chart of 1701 was expanded to embrace the navigable parts of the whole world, and brought up to the epoch 1756 by Mountaine and Dodson, whose labours were followed by those of Churchman in 1794, Yeates in 1817, and Hansteen (for several distinct epochs between 1600 and 1787) in 1819. In 1833 Barlow's chart, together with curves for the North Polar regions, accompanied a descriptive paper in the *Phil Trans* for that year.

In 1840 Gauss and Weber's charts of theoretical curves of the three magnetic elements for the whole world, including special Polar charts, were published. These curves were calculated on the basis of a mathematical theory founded upon a large number of observations fairly distributed over the surface of the globe.

About this latter period the practice of ascertaining the errors of the compass on shipboard (as due to the effects of iron) for every ship in the Royal Navy, at certain periods and on change of magnetic latitude, was established by the Admiralty on the recommendation of a compass committee specially appointed to consider the question of compass efficiency and management This, as bearing on the subject under review, was an important step towards obtaining reliable data for the construction of Variation charts now becoming so essential an element in navigation

Following on this, Archibald Smith's mathematical investigations of the theory of the deviations of the compass on board ship enabled Sabine to correct observations made in the Atlantic and the Antarctic Oceans

with great precision. The charts accompanying Sabine's "Contributions to Terrestrial Magnetism," No IX. (*Phil. Trans.* 1849), were among the earliest on which the data whence the curves were drawn are recorded, although it may be observed that even a portion of the observations made at sea and utilised in these charts had no corrections applied to them for the effects of the ship's iron.

Considering the local magnetic disturbance found to exist on land in many regions and the large area of water-covered portions of the globe, observations made at sea, when systematically carried out and corrected for local attraction in the ship, have become an important factor in ascertaining the magnetic variation for the use of navigators at any given epoch

Evans's Variation chart for the epoch 1858, embracing the navigable parts of the world, and in which the whole of the observations made at sea were corrected for the effects of the ship's iron, was published by the Admiralty A further advance on Variation charts of an earlier date was the addition to this of a map showing the amount of annual change of the variation as determined at several localities, enabling reductions for the succeeding ten years to be made with a reasonable approach to the truth

The increase of iron-built and composite vessels in late years has rendered a reliable Variation chart a necessary adjunct to navigation This object appears to have been kept steadily in view by the Hydrographic Department of the Admiralty, for, in 1871, a new edition of the "Variation Chart of the World," reduced to that epoch (with polar charts added) was published in continuation of the chart for 1858. This chart was the result of the joint labours of Capt. Evans and a member of the compass department, Navigating-Lieut. Creak, R N

We have now to notice the more recent publications of these contributions to terrestrial magnetism A chart of the curves for 1880, in continuation of those for the epochs 1858 and 1871, by Staff-Commander Creak, has been published by the Admiralty In its construction the observations made during the voyage of H M S *Challenger* (1872-76) have been introduced, and amongst results from other sources, specially those taken from Mr A Schott's papers on the secular change of the variation published as Appendix No 8 to the U S Coast Survey Report for 1874, and also as a preliminary publication to the Report for 1879, Dr Thorpe's observations in the United States, made about the 40th parallel of latitude, and results from the maps of the excellent magnetic survey of a large portion of the Eastern Archipelago in 1874-77, made by Dr Rijckevorsel, have also been included.

As confined to special portions of the world a map of the United States for the epoch 1875, constructed by Mr J. E. Hilgard, Assistant U S coast and geodetic surveys, published in the *American Journal of Science* for March, 1880, and illustrating an article on the subject of magnetic variation or declination, is of a high order of excellence

In this map the curves, which show several flexures strictly pourtraying results arising from local disturbance, have been drawn for every degree of [equal] variation The results are from observations made during the progress of the U S Coast Survey up to 1877, also from about 200 observations made in the interior of the country under the direction of Mr. Hilgard, to which were added every available observation from the land and boundary surveys, as well as those of private observers. Many of these results having been obtained at different periods of time, have been reduced to the given epoch by means of Mr. A Schott's paper on Secular Change before referred to.

Although in maps and charts covering large geographical areas the variation lines for the land portions are generally drawn in regular curves (and so far deviating from strict accuracy), whilst those for the larger sea areas are necessarily so done, still in delineating the magnetic features of a portion of a continent the system followed by Mr Hilgard, as also by Lamont in his European surveys between 1850 and 1860, commends itself for accuracy

The late Prof A D. Bache, who took a personal interest in the study of terrestrial magnetism, bequeathed a fund for scientific research. The expenses of obtaining the 200 observations in the interior of the United States before mentioned, were defrayed by a grant from this fund.

THE ZOOLOGICAL STATION AT NAPLES

"WHAT *is* a zoological station?" is a question we have often heard asked when Dr Dohrn's institution at Naples is under discussion A "zoological station" (according to Dr Dohrn), we may reply, is a kind of zoological garden for marine animals, or what is commonly called an "aquarium," only that, contrary to the usual practice at Brighton, Westminster, and elsewhere, the scientific element of the establishment is mostly cultivated instead of the popular branch Such at least is the case under Dr. Dohrn's system, and also, we believe, in other zoological stations that have been formed after his example

It must be recollected that the lower forms of organic life, to the study of which zoological stations, as thus described, are mainly devoted, are much more numerous than the vertebrata, and much less understood Even in our own seas a vast amount remains to be done before our knowledge of the thousands of marine organisms which populate our waters and shores can be deemed to be anything like complete Still more is this the case in the Mediterranean, where under a bright sky and burning sun the clear waters teem with animal life in all its varieties It was no doubt the well known productiveness of the coast of Naples and the facilities offered for dredging in its land-locked Bay that induced Dr Dohrn to fix his "Zoological Station" in this quarter instead of planting it on the shores of his Fatherland

After several years of incessant labour Dr Dohrn has got his establishment into excellent working order, and, as will be seen by our advertisement pages, promises us after so much cultivation a rich and abundant harvest The proper subject to take up when the publication of results was determined upon was obviously the Biology of the Bay of Naples Great difficulties however beset the advance of this project As regards the Fishes, the more highly-organised Crustaceans, the Mollusca, and some of the Cœlenterata and Echinodermata, it appeared possible for the students at the Zoological Station to avail themselves largely of the results arrived at by former workers But when they proceeded to examine into the scattered literature in which the innumerable armies of Lower Crustaceans, Annelids, Nemertians, Planarians, Nematodes, and such-like creatures are described, the case was very different The ancient naturalists have mostly characterised their species in these groups in such vague diagnoses that it is impossible to identify them Under such circumstances the students of the higher animals are accustomed to resort to the type-specimens whence the descriptions were taken in order to see what the authors really intended. But the impossibility of preserving many of the lower animals cuts this resource away from the marine zoologists, who have consequently contented themselves in some instances with referring their specimens to species never sufficiently described, in other cases with describing them as new Hence has arisen a mass of confusion which can be only regarded as parallel to what existed among the more highly-organised animals in the ante-Linnean period. The transformations undergone by many of the lower marine animals and the extraordinary sexual differences add

greatly to the difficulties already spoken of Even when an animal of one form is gravely suspected to be merely the immature stage or corresponding sex of another form it is most difficult to prove it, and it frequently requires a whole series of researches conducted by practised biologists with logical exactitude to show that such is really the case

Under these circumstances, even with the now rich collections and well-stored library of the Zoological Station, it was a serious question how the proposed "History of the Life of the Bay of Naples" could be best accomplished Dr Dohrn has wisely adopted the project of attacking the fortress by a number of small approaches By dividing the labour into a large series of restricted monographs he hopes finally to accomplish a complete account of the fauna and flora of the Bay of Naples In the first place, under this system each of his assistants can thus take up the group he is most familiar with, and work it out Then in this way he is likewise able to secure the contributions of various naturalists who pay temporary visits to the Zoological Station, but who would not bind themselves to join in an extensive general work on the whole subject

It will be seen by reference to our advertising columns that Dr. Dohrn's scheme thus elaborated is now on the eve of execution Two of the proposed monographic memoirs on the Ctenophoræ by Dr Cheen of Leipsic, and on the Fishes of the genus *Fierasfer*, by Prof Emery of Cagliari, are already issued, and three other memoirs are announced as being in preparation for the present year Dr Dohrn is quite cosmopolitan in his arrangements Though, as might have been expected, the greater number of his fellow-workers are natives of the Fatherland, he has many Italian co-operators, and the monographs may be written in German, Italian, English, or French It is with some regret we observe that no English naturalist is yet on the list of contributors, although, as is well known, many of our countrymen have done good work on Dr. Dohrn's "tables." We trust that English recruits may still be enlisted in so good a cause, and that the "Fauna and Flora of the Bay of Naples" may attain to a goodly list of subscribers, and be brought to a satisfactory conclusion.

CHARLES FREDERIC KUHLMANN

WE regret to record the death, at Lille, during the past week, of Charles F Kuhlmann, the distinguished French chemist and economist Born at Colmar, May 22, 1803, he pursued his scientific studies under Vauguelin at Strassburg, and later at Paris In 1832 he was appointed Professor of Applied Chemistry at Lille. Soon after he devoted himself almost exclusively to the practical solution of the problems of manufacturing chemistry, and established at Lille extensive works, which rank today among the important chemical manufactories of the world During the past forty years he has been a prominent figure in the industrial, scientific, and even political circles of France, attracting general admiration by a remarkable combination of inventive power and executive ability The Government named him Commander of the Légion d'Honneur, and the French Academy of Sciences elected him a corresponding member, in recognition of his important services, while he was frequently called upon to occupy prominent posts of responsibility in public life and commercial undertakings. His failing health during the past year forced him to decline one of the leading honours in the scientific world of France, the presidency of the Société Française pour l'Avancement des Sciences

As an investigator Kuhlmann was a prominent member of that group of Alsatian chemists which includes Wurtz, Friedel, and Schutzenberger, and forms the chief school of modern French chemistry His researches, extending over nearly every department of inorganic chemistry, and touching on the tinctorial branches of organic chemistry, are characterised by a broad range of knowledge, a happy application of fact and theory, and a marked reverence for the demands of pure chemistry, while contributing so notably to the advancement of applied science.

First among his great researches mention should be made of that on baryta compounds, made over twenty years since, and by means of which he created the entire industry of this important group of salts Another investigation, scarcely less valuable, was that made a few years previously, which led to the introduction of the process of saturation in the manufacture of sugar. Equally prolific of practical results were his extensive studies on the crystallisation of insoluble bodies, on the chemistry of mortars and cements, of manures, of bleaching, of dyeing and printing, and of numerous other branches. Especially interesting were his researches (1847) on the formation of nitric acid from ammonia, and on the relation of this reaction to the fertility of the soil. Among his more purely scientific investigations mention should be made of those on the formation of ethers, on the formation of cyanides and of prussic acid, on nitrous oxide, on the use of oxide of iron as an oxidising agent for organic compounds, on the action of gases on minerals, on the use of gaseous hydrofluoric acid for the analysis of silicates, and on a variety of minerals The subject of crystallisation was throughout his career of investigation one of Kuhlmann's favourites, and we are indebted to him for the artificial reproduction of a variety of natural minerals, the most novel of which are the pseudomorphic forms of protoxide of manganese, of the sulphides of copper and lead, and of these metals themselves.

In 1879 Kuhlmann gathered together his numerous researches, extending over a period of forty years, into a volume of 750 pages, in which we have a remarkable picture of his many-sided and untiring activity

The deceased leaves behind him a son who has already obtained a name as a chemist, and who made an able report to the French Government on the Chemical Section of the Philadelphia Exhibition T H. N

THE SCIENTIFIC SOCIETIES OF DUBLIN

OF the scientific societies of Dublin two take special rank as publishing societies, but from inquiries made of us we conclude that their publications are not everywhere known

The Royal Irish Academy issues both *Transactions* of a quarto size and *Proceedings* in octavo Of its series of *Transactions* 26 volumes have been published Of these vols 1 to 23 contained memoirs chiefly on Science, but occasionally on Polite Literature and Antiquities Vol. 24 was divided into two sections—the first, Science, the second, Polite Literature and Antiquities Vols. 25 and 26 were exclusively Science Vol 27, in course of publication, is devoted to Polite Literature and Antiquities, and vol 28, which also is in course of publication, is devoted to Science. These quarto volumes contain from 600 to 700 pages each, with numerous plates and other illustrations To give some idea of their contents we add the following analysis of vol 26 It contains papers on Astronomical Subjects by Dr. Doberck (2), J Birmingham, J L E Dreyer, and C E. Burton, on Meteorological Subjects, by Dr. H. Lloyd; on Geological Subjects, by Rev. Dr. S. Haughton, Dr. E. Hull, Dr. A. Leith Adams, and Prof. O'Reilly (2); on Mathematical Subjects, by J. C. Malet (3), Dr. A. S. Hart, Dr J Casey, on Biological Subjects, by Dr R. J Harvey, Dr. E P Wright (4), and W. H. Mackintosh, on Chemical Subjects, by H N Draper and R. J. Moss. The memoirs which form the volumes of *Transactions* are published shortly after they are read, and without waiting to form a part of a volume. The *Proceedings*, like the *Transac-*

tions, now also form two series the Science Parts being published twice a year, in December and April, and the Polite Literature and Antiquary Part once a year, in December. Quite recently the Academy have determined to publish another series of quarto *Transactions* under the title of "The Cunningham Memoirs," part 1 of the first volume of which, containing a memoir by Dr. John Casey, F.R.S., on Cubic Transformations, has just appeared

The publications of the Royal Dublin Society are of the same type as those of the Irish Academy, except that they are exclusively confined to science. Of their new series of *Transactions*, parts 1 to 13 of volume 1 have been published, and for convenience of publication the first two parts of volume 2, containing "Observations of Nebulæ and Star Clusters, 1848–1878," by the Earl of Rosse, have also appeared. The first two volumes of these *Proceedings* have been published, and a part makes its appearance pretty regularly every third month Following the example of the Academy, the memoirs forming the *Transactions* are published separately

It would thus appear that not only is there evidence of scientific life among the societies of Dublin, but that there is also an abundant opportunity for the publication of any really valuable scientific information, and so far at least as the publications of the Irish Academy are concerned they fall in no respect as regards type, paper, or illustrations, behind the best of our London societies

JOHN DUNCAN

ALONG with a cheque for 5*l.* to John Duncan, whose story was told by Mr. W. Jolly in NATURE of January 20, we have received the following note from Mr W. Westgarth —

January 27, 1881

DEAR SIR,—On reading the account of John Duncan in your last week's issue, it occurred to me that surely your readers would respond to your invitation to get up a small fund, say of 100*l.* to 200*l.*, for the brave old man who has so long and perseveringly fought, and against all "odds," for the cause of science and mind. I enclose 5*l.* towards the object Should you see objections to opening a list in NATURE, please send on my small dole to Mr Jolly as he directs W WESTGARTH

We have the greatest pleasure in acting upon Mr Westgarth's hint, and we trust that many of our readers will be prompt to follow his good example Subscriptions addressed to the Editor of NATURE, 30, Bedford Street, Covent Garden, W C., will be duly forwarded We have already received the following :—

	£	s.	d
W. Westgarth	5	0	0
Publishers of NATURE	5	5	0
F R.S.	0	10	0
Mrs. Forster	1	0	0

CASSELL'S NATURAL HISTORY[1]

THE third volume of this useful cyclopædia of zoology consists of the concluding portion of the Birds by R. Bowdler Sharpe, and of the Reptiles and Amphibia by the Editor On glancing over the well-printed and beautifully-illustrated pages, a few facts have struck us, to which, for the benefit of the series, we would call the editor's attention In the opening sentence of Chapter I. of this volume we are referred to "the preceding chapters" for an account of the Picarian birds. The context proves it should be to the preceding volume. This, which might mislead the reader, is evidently the result of the publication of the work in parts, and could be easily avoided.

All through Mr Sharpe's portion of the work, when the scientific names of birds are referred to they are quoted generally within brackets in the same line as the popular name, while in the editor's special portion no such useful uniformity is attended to Sometimes, as on p 245, the eye has to wander from the text to foot-notes at the bottom of the page, sometimes, as at p 248, the name is quoted after Mr. Sharpe's fashion (for a mixture of both styles see p 362) The use of the word "kind," when the editor refers to "species," is in our judgment, though perhaps sanctioned by its use in the English translation of the Bible, not happy Thus we read that, while genera among the reptiles are abundant, "kinds" are numerous. The "kinds" of some families swim freely, some "kinds" have a skin, by the way, what kind of a reptile be it that has *no* skin? In other cases the word "member" instead of species is used Is it not a mistake to say that in many Chelonians "the well-known 'tortoise-shell' covers over all the hind parts." Surely in *Caretta squamosa* the tortoise-shell plates cover over most of the carapace While the families of the Chelonian order are given, we find, when we come to the Lacertine order, no intelligible mention of the families of the split-tongued lizards. In referring to the important paper on Archæopteryx by the Professor of Geneva, the editor ought to have seen that the name of Carl Vogt was correctly spelled The divisions of the Snakes is such as must necessarily confuse any student. The sub-order Thanatophidia is made to include two sub-orders in the text, when in the table of classification one of these sub-orders, Solenoglypha, is called a family. The groove-fanged Opisthoglypha are included with the Aglyphodontia with solid teeth In a work of this nature nothing is, we take it, of more importance than that there should be some well-defined system of classification, not necessarily to be treated of in full detail, but as far as is possible to be rigidly adhered to That this is possible, a glance over the sections of this and the previous volume treating of Birds will abundantly demonstrate, and that this is practicable, even with an extreme compression of space, is also to be proved by an appeal to the way in which the eighth order of Birds is managed, where, though only three pages were allowed to this most interesting and important of orders, yet we are even in these few lines enabled to get an idea of the orderly sequence of its families This work is in many ways so excellent, that we venture on these criticisms with the object of trying to keep it up to a fairly good standard, and of making it useful in some measure as a work of reference.

As specimens of the excellent illustrations in this volume we have, through the courtesy of the publishers, the opportunity of presenting to our readers the two following. The Common Quail (*Coturnix dactylisonans*) visits Europe in the summer, when prodigious numbers are trapped and sold for purposes of food. Waterton mentions that 17,000 specimens were brought to Rome in one day They are to be found in large quantities on the coasts of the Mediterranean, and so abundant are they in the beautiful Island of Capri, that it is said that it was from this source that the bishops in the olden times derived a large part of their wealth The Quail is most rapid in its flight, and performs long and fatiguing journeys Sunset is its time for active exertion, during the day it remains quite quiet, reserving its energies for the evening, when it goes off in quest of food.

Their favourite nourishment is insects, but at times they feed on grain and seeds, small stones are also swallowed to facilitate digestion The habits of the quail are most unamiable and unsocial, and generally, when they meet with one of their own species, they display a very pugnacious disposition The female has a much better nature, she is a most excellent mother, even protecting young birds who have been deprived of their parents' care She builds her nest of small portions of plants, and lays eight to fourteen eggs, these are pear-

[1] "Cassell's Natural History" Edited by Prof P Martin Duncan, M B, F.R S Vol III. (London, Paris, and New York Cassell, Petter, Galpin, and Co., 1880.)

shaped in form, of a light-brown colour, marked with a darker shade; the young seem full-grown when only six months old, and are ready to join their parents in their long autumn journey, which may extend as far as the Cape of Good Hope, where they are known to arrive in large numbers. The quail, unlike the partridge, also figured in our illustration, has several wives, and displays great spirit in keeping rivals at a distance; while the mother is attending to the care of her young ones, the cock bird, too, often amuses himself in the vicinity with his companions.

Our second illustration is taken from the higher of the two classes of the Ichthyopsida, known as the Amphibia; these skull-bearing animals have no amnion and but a rudimentary allantois, and they breathe by gills at some period of their life. In this volume they are placed as an independent class alongside of the Sauropsidian reptiles. Among the permanently tailed Amphibians (Urodela) the sub-order containing those species with gills that fall off (*Caducibranchiata*) contains the interesting species known as Salamanders. It is of one of these of which we give the accompanying figure, not only as a fair specimen of those in the volume we are reviewing, but also in the hope of awakening some interest in a rather uncommon

FIG. 1.—The Partridge and the Common Quail.

Amphibian. "The next genus [to Salamandra], Pleurodeles, has *short* ribs, which give the appearance as if they penetrated the flanks, but their ends come against the tissue under the skin and produce horny projections thereon. The tail is long and compressed, and the small tongue is *adherent only in front*, and there are two series of palatine teeth in longitudinal series. The Spanish kind (*P. Waltlii*) has an ashy grey body, very prettily marked with long transverse stripes and dots. It is like a heavy lizard." Lord Clermont, in his useful work on the Reptiles of Europe, describes the tongue as small, warty, free behind and on the sides, adhering in front; he also describes the ribs as piercing the skin, and they are also said by some to be capped by horny tubercles, but this is denied by Leydig. Prof. St. George Mivart tells us that this species differs from all the other Urodela in the length and strength of its ribs, the longer ones considerably exceeding the length of two of the longest vertebræ of the body. M. Waltl first discovered it at Chiclana in Spain; Schinz states that it is very common in Andalusia in tanks and cisterns of water; Wallace gives its distribution as Spain, Portugal, and Morocco. Lord Clermont hints that the *Bradybates ventricosus* of Tschudi is probably the young of this species.

Now when Lord Clermont wrote his book there was not much more known about this interesting little animal,

but some sixteen months ago Dr. F. Leydig of Bonn published an excellent account of it in *Wiegmann's Archiv*, in which he gives a short account of Dr. Joseph Waltl, who first discovered Pleurodeles, and of the gallant Dr Michahelles, who called it after his friend, its discoverer (1830). Among the specimens sent to Bonn, one was living, and in it could be easily seen the tips of some of the ribs sticking through the skin; and that "this penetration" of the skin of the sides was not in the first instance caused by or through the transport, the accompanying note from the kind sender proved. "You will remark that in the Pleurodeles the ribs pierce the integuments, and that if this be an accident, it is in some sort a physiological one." The habits of the Pleurodeles seem to be more or less like that of our native Tritons. During the procreative season they remain upright in the water; later they leave it and hide themselves in damp places under stones. Like the Water Newts, they possess a sort of cry, when frightened, as on being suddenly seized, they emit a low, short, almost squeaking sound, generally repeated several times. This seemed to come not so much from the throat as to be caused by a rapid expulsion of air through the openings of the nose—in fact, to be a sort of snort.

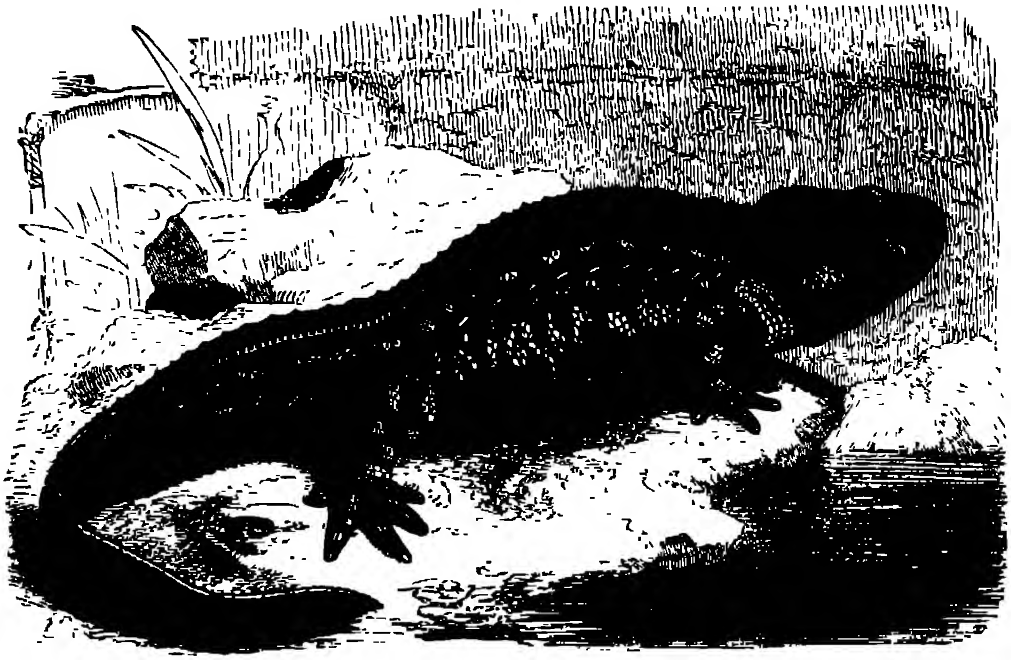


FIG 2—*Pleurodeles waltii*

It had a tendency to crawl vigorously backward when uneasy, by prising the ends of the ribs against the skin. this snake-like progression no doubt causing the skin openings Prof. Leydig's specimen lived on slugs of small size, which it took eagerly as well as worms, indeed preferring these latter. The skin surface was rather dry than clammy The colour changes through the chromatophores were clearly to be noticed, during cold weather it was of a tolerably uniform dark, when warmer the colour became lighter, numerous dark spots standing out from a light gray ground colour. On very warm days it would lie for hours motionless on the surface of the water.

It would almost seem worth one's while to pay a visit to those Andalusian tanks, and by their semi-limpid sides and under the shelter of their surrounding fig and olive-trees work out the complete history of this interesting little form

These woodcuts will show that in point of illustration this volume keeps up with both its predecessors in effect, while we have gently hinted at a few blemishes, the work deserves a very considerable mead of praise, and we heartily recommend it as an excellent volume to be placed in the hands of all interested in the animal kingdom

NOTES

THE *Akhbar* published a programme of the excursions which have been arranged for the next session of the French Association at Algiers on April 14 The excursions are very numerous, and are classified according to the length of time required for their completion. One of the most attractive in the vicinity of Algiers is the tomb of the Kings of Mauritania; Laghouat and the desert is one of the most protracted, and requires eight days for its completion. The travellers will enjoy unexampled facilities for visiting the country The seat of the French Association is 76, rue de Rennes, Paris. Applications are to be made to M. Gariel, Professor of Physics to the École de Médicine, permanent secretary. A reduction of 50 per cent has been granted by the railway companies, the arrangements made for the sea passage will be published in proper time. An influential local committee has been established in Algiers. M. Chauveau, Professor to the Veterinary School of Lyons, has been appointed president of the session, the vice-president is M. Janssen.

MINERALOGICAL science has suffered a great loss by the early death, on January 27, of Prof Dr Emanuel Boricky, who was well known by his microscopical researches in petrography Boricky was born at Milin, near Pribram (Bohemia) in the year 1840, and he had therefore just completed his fortieth year. In 1865 he became an assistant of the mineralogical section of the Bohemian Museum, and in 1866 he was named Assistant Professor of Mineralogy at the University of Prague Having attained the degree of a Doctor of Philosophy, he became a teacher of mineralogy at one of the colleges of Prague in 1868, and in 1869 he was promoted to the post of a custos of the mineralogical collections at the museum. Since 1871 he ha

lectured in the Bohemian language on petrography at the University of Prague. He was a diligent and successful worker in science, and his microscopical researches have made his name familiar to mineralogists far beyond the boundaries of his native country. He has left a monograph on the porphyries ready for printing. Science has lost in him a devoted student, and the Bohemian nation regrets the death of one of its best sons.

THE *Times* announces the death of Mr. William White, a well-known chemist and mining authority. Mr. White was the author of numerous works, including the "History of Chemistry," "Economy of Health," "Chemistry of Vegetation," "Chemistry for Students," "Hints from a Chemist," "Mineral Resources of Newfoundland," &c., and was for over half a century a constant contributor to scientific literature. He had held at different periods lectureships on metallurgy and chemistry at various educational establishments, and had earned for himself a reputation as a lecturer and writer on agricultural chemistry. He died in London on Sunday last, at the age of seventy one, from a painful disease contracted while conducting experiments in his laboratory.

THE Prussian Government, according to Berlin papers, intends to purchase the Godeffroy Museum at Hamburg for the Berlin Anthropological Museum. The former is one of the most interesting zoological and anthropological collections, particularly with regard to Eastern Asia and the islands of the Pacific; it was formed by the Hamburg firm of that name by means of special scientific expeditions during the last decades.

THE Senatus of Glasgow University has just been presented with a portrait of the Very Rev. Principal Caird, the esteemed head of the University, and Mrs. Caird with a replica. The portraits are the gift of subscribers belonging to all religious and political parties, and are the works of Mr. Millais, R.A. The Principal is represented in academic dress, and the likeness is very striking. The portrait presented to the Senatus will be placed in the University library, the walls of which are already adorned with likenesses of former principals and professors.

M. MARIETTE, better known as Mariette Bey, the celebrated Egyptologist, has died in Alexandria. M. Maspero, his pupil, Professor of Egyptology to the Collège de France in Paris, has been appointed by the Egyptian Government to fill the place vacated by the death of M. Mariette.

A PROPOSITION has been made by the *Operator* and other electrical papers of the United States to open at New York an international exhibition of electricity in 1882. It is stated that the United States Congress will vote a sum of money to subsidise the American exhibitors at the exhibition of this year in Paris.

THE Royal Commission appointed in 1879 to inquire into the cause of accidents in mines have concluded the taking of evidence. The attention of the Commission is now directed to a series of experiments as to the explosive nature of coal dust, as to the best kind of safety lamp, and as to other matters designed to elucidate the causes of explosions. It is proposed that some experiments shall take place to test the efficacy of the electric light as an illuminating power in mines.

THE Committee formed for the exploration of the remarkable holes, which have recently appeared on the surface of Blackheath, have been negotiating with an experienced well-sinker, and intend to commence active operations in the course of a few days in the hope of finding a clue to their origin. Contributions in aid of the work, from persons interested in the investigation, will be gladly received by the honorary treasurers of the Committee—Dr. Prior Purvis, Landstown Place, Blackheath, or Mr. E. W. Brabrook, F.S.A., director of the Anthropological Institute, 28, Abingdon Street, Westminster.

ORDINARY MEETINGS of the Sanitary Institute of Great Britain, 9, Conduit Street, W., for the reading of papers and discussion upon sanitary matters, will be held during 1881 on the second Wednesday in the months of February, April, and June, chair to be taken at eight o'clock precisely. At the first meeting, February 9, a paper will be read by W. H. Michael, Q.C., upon "The Law in Relation to Sanitary Progress," to be followed by a discussion.

AN earthquake was felt over a considerable area of Switzerland on January 27. It was felt with varying degrees of intensity at Berne, Muensingen, Thun, Basle, Solothurn, Zurich, Bienne, Oberhofen, and Aarberg. The principal shock occurred at 2.20 in the afternoon, Berne mean time. A slight shock was observed at three o'clock the same day, and another equally slight at six the following Friday morning. According to a report of the Berne Observatory the first and principal shock was in the direction from east to west, with a slight northerly deviation. The oscillation was both vertical and lateral, and according to some accounts, was preceded by a rumbling subterranean sound. Its intensity may be judged from the facts that the chimes in the church clocks were made to strike and the bells to toll, books were thrown from their shelves, and pictures detached from the walls, while in Berne alone more than 100 chimneys were thrown down. This is the twenty fourth earthquake that has been recorded in Switzerland since November, 1879, and is probably the most severe.

A SHOCK of an earthquake was felt at 5 p.m. on January 24 at Bologna, Florence, Venice, Padua, Ferrara, &c. At Bologna there were also slighter shocks at midnight, and at 8 and 9.15 a.m. next day, while Florence likewise had a second shock at 7.53 a.m. on the 25th.

IN a recent number of the *Journal de Physique*, of which the late M. d'Almeida was so long the editor, the following interesting episode is narrated.—During the investment and siege of Paris by the German armies in the winter of 1870-71 M. d'Almeida took a prominent part in certain attempts to re-establish telegraphic communication between Paris and the provinces, using the River Seine as a conductor. This suggestion originated with M. Bourbouze (of galvanometer fame), who was, after the war, created a chevalier for his suggestion. It was proposed to send powerful currents into the River Seine from batteries at the nearest available point outside the German lines, and to receive in Paris, by delicate galvanometers, from the river such a portion of these currents as might not have leaked into the earth. After some preliminary experiments had been made between the Hôtel de Ville and the manufactory of M. Claparède at St. Denis, by Professors Desains, Jamin, and Berthelot, it was decided to make the attempt, and accordingly on December 17, 1870, M. d'Almeida was despatched by balloon to the provinces in order to try to establish this novel mode of telegraphy without wires. The balloon descended after sundry perils in the Arcadian solitudes of Champagne outside the Prussian lines. Thence he proceeded *viâ* Lyons and Bordeaux to Havre. Not finding suitable appliances and apparatus, there was again a delay in sending to England for the necessaries, which on arrival were conveyed to Poissy, where M. d'Almeida regained the banks of the Seine on January 14, 1871. Here however the frost proved inimical, the river having been frozen hard since the beginning of December. The attempts at communication were however to have been made on January 24, when the armistice was proclaimed. It was too late; and the world missed a famous scientific exploit from amongst those which made the siege of Paris notable beyond all other sieges of history.

M. JULES FERRY, French Minister of Public Instruction, and M. Tirard, Minister of Agriculture and Commerce, paid an

official visit the other day to the schools of apprenticeship established at the expense of the City of Paris in the rue Herold and the boulevard of La Villette. The time required for the scientific education of the young workmen is three years During the first year the pupils are trained in working wood as well as iron. The choice of the speciality is only made at the beginning of the second year. No work is executed without a drawing having been made, so that the workman is enabled to understand the use of the object he is manufacturing Regular courses of lectures are given in the establishment on scientific subjects. Meanwhile experiments are conducted in three different primary schools, to determine whether it is possible to join manual to mental training in all the city schools.

PROF. HULL has published a fourth edition of his "Coal-Fields of Great Britain" (Stanford). This edition has been largely rewritten, and contains an entirely new chapter on Carboniferous Plants, by Prof Williamson, F R.S. The Classification of the Carboniferous Series of Beds has been modified in accordance with the views enunciated in Prof Hull's paper on this subject read before the Geological Society in 1877. Various other modifications have been made in accordance with the results of recent geological research, and the statistical portions have been brought down to 1878.

MESSRS. LONGMANS AND CO. send us the fourth edition of Prof Atkinson's "Natural Philosophy for General Readers and Young Persons," translated and edited from Ganot's French work To this edition have been added twenty five pages of new matter and sixteen additional illustrations.

MR. E S BAKER, photographer of Bristol, sends us a photograph of a jar, which is a fine illustration of the fact that water expands on freezing During the recent frost the water in the jar froze, and the ice is seen protruding from its mouth to a considerable distance like a well-shaped cork.

MR. C. V. RILEY of 1700, Thirteenth Street, Washington, writes to us that, having been obliged to cease the publication of the *American Entomologist*, he has a few full sets of vol iii., just closed, to dispose of, and has concluded to send the full volume to all former subscribers who may want it, or to any Library, Natural History Association, or editor of journal, postage prepaid, at the reduced price of $1.50. The information in the magazine, Mr Riley states, is of permanent interest, and the volume will be of value to any one interested in entomology in any of its bearings

M. CH. JOLY has republished as a pamphlet a paper which he lately contributed to the *Journal* of the National Horticultural Society of France, under the title of "Note sur une Exposition de Géographie botanique et horticole, organisée par la Société Centrale d'Horticulture de Nancy"

NEW SOUTH WALES, Victoria, and South Australia have agreed to jointly bear the expense of exterminating the *Phylloxera vastatrix*, the alarming extension of which in Victoria has threatened the destruction of the wine industry.

WE have received the three first numbers for this year of the *Chicago Field*, which seems modelled on a small scale after its well-known English contemporary.

THE *Revue Scientifique* of January 29 contains a lecture recently given at the Sorbonne by M. Faye, on the Volcanoes of the Moon

AT Cracow a new Polish review for literature, science, and art is now being published fortnightly. Its title is *Museum*, and its editor Dr. Thaddaeus Rutowski.

THE works in the Arlberg tunnel are progressing. On the Tyrolese side the lower shaft has been pushed to a distance of 340 metres, by help of the boring machines, and in spite of the hardness of the rock the daily progress is two metres. The upper shaft is some 100 metres behind.

A NUMBER of Roman antiquities were found last year during some military earthwork operations near Metz, close to the Lunette d'Arçon. It appears that the place was one of the most important burial-places of Roman Metz. The Metz Geological and Archæological Society gave the details at its last December meeting Some thirty-five vases, four metal objects, three coins, and two tombstones with inscriptions are mentioned. Of human remains four skulls were found, one of which was lying upon a square stone plate, besides carbonised (cremated?) bone remains in a round stone urn The inscriptions were epitaphs, of the three coins, one dated from the year 41 (when Claudius commenced to reign), another from the year 160 (reign of Antoninus Pius) Prof. Schaaffhausen of Bonn states that three of the skulls found belong to three different tribes. One belonged to a German, another to a Frisian, the owner of the third came from so far a country as Lapland.

A REMARKABLE discovery of Russo-byzantine antiquities was made near Kiew some weeks ago, when a canal for the water-works of the city was being excavated. They consist principally of twenty gold and enamelled lockets, three buttons of the same materials with heads of saints upon them, gold rings, agraffes and studs, all dating from the fifteenth or sixteenth century; they doubtless served as ornaments upon the costumes of the grand princes. Besides these some thirty-four silver coins were found, also a highly original bronze vessel in the shape of a fabulous quadruped The metal value of all the antiquities is estimated at 1000 roubles (150*l*.). The Archæological Commission has taken possession of them.

OUR ASTRONOMICAL COLUMN

THE OBSERVATORY OF HARVARD COLLEGE, U S.—We have received the Annual Report presented to the Visiting Committee of this Observatory by Prof. Pickering on December 6 The year has been one of unusual activity in the establishment, funds which had been liberally forthcoming from its friends having enabled both the equatorial and meridian circle to be regularly employed, and further having allowed of many researches of importance being conducted with the smaller instruments With the large equatorial Prof. Pickering claims that he has succeeded in making a more extensive series of observations for position of the satellites of Mars at the last opposition than was obtained elsewhere, and states that Deimos was last seen at Harvard Observatory, the number of observed angles of position of Deimos was 825, and of Phobos 278, and that of observed distances 245. In addition to measures for position photometric observations were made, which appear to show that if the satellites possess a capacity for reflecting sunlight equal to that of the planet, Deimos may have a diameter of about six and Phobos of seven miles. It was noted at various observatories that Deimos appeared somewhat brighter in 1879 than at the preceding opposition in 1877, and in both years Prof Pickering states it seems to have been brighter measured photometrically, and to have been seen more easily when it followed than when it preceded Mars.

Photometrical determinations of the times of eclipses of Jupiter's satellites, commenced in the summer of 1878, have been continued during the year, and it is considered with reasonable hope that these phenomena may be more accurately observed than hitherto by this method Observations of planetary nebulæ described in the previous Report have been nearly completed.

With regard to spectroscopic observations, Prof Pickering says the most remarkable discovery is that the spectrum of No. 17681 of Oeltzen's Catalogue, the place of which for 1880 is in R A 18h. 1m. 17s, N P D 111° 1', possesses a peculiar character. "The light of this star is principally concentrated in two points of the spectrum, one in the blue, the other in the yellow, a little more refrangible than the D line. A faint continuous spectrum is also seen."

The variable star of Ceraski, the true period of which was determined at Harvard College, is referred to, systematic observations have been made upon it. The Report describes the progress made in observations with the "meridian photometer," whereby it is intended to determine the light of all stars visible to the naked eye between the North Pole and N.P.D. 120°. The principal want of the Observatory at the present time is stated to be the means of publication of these and other classes of observations, the large number of volumes issued during the last five years having exhausted the funds specially appropriated for defraying expenses of publication.

CERASKI'S VARIABLE STAR T CEPHEI.—Prof. Julius Schmidt, from his own observations of minima of this variable in the last five months of the past year, finds reason to conclude that in that interval each successive period was longer by 0·08753m. or 5·25s. than the preceding one, and has calculated the times of minima upon this assumption between June 11, 1880, and February 15, 1881. For elements with this correction to the period to be applied, he adopts for his starting-point—

Minimum . 1880, December 7, 10h 6·7m
Athens M.T. + 2d 11h. 50·812m. E

E being the number of periods from December 7. Thus the next minimum is found to occur on February 5, at 6h. 50·3m. Athens time, or at 5h. 15·4m. M.T. at Greenwich. Prof. Schmidt has remarked what we believe was soon detected by Mr. Knott from his observations in October last, that for more than two hours about the minimum there is no perceptible variation of brightness, decrease and increase are very rapid, particularly the latter.

SWIFT'S COMET, 1880 *e*.—The Superintendent of the Observatory at Washington, Admiral Rodgers, communicates to *Science* of January 10, an orbit of this comet which has been calculated by Prof. Frisby from three meridian observations made there on October 25 and November 7 and 25, and without any assumption as to the periodic time. The revolution resulting from this application of the general method is about 2178 days, or a little less than six years, and thus the conclusion arrived at by MM. Schulhof and Bossert of Paris, and Mr. S. C. Chandler of Boston, U.S., receives confirmation. From the position of the orbit it happens at present that only every second return to perihelion can be made available for observations.

BARON DEMBOWSKI.—Practical astronomy has sustained a severe loss in the death of Baron Ercole Dembowski, which took place on the evening of the 19th ult. at Monte, Frazione di Solbiate, Arno. Few have attained as great skill or exhibited greater industry and patience in that somewhat difficult and tedious branch, the measurement of the double stars, to which the Baron specially devoted himself, and we hope some means may be found of publishing in a collective form the results of his long-continued labours in this direction.

METEOROLOGICAL NOTES

OUR readers will learn with much satisfaction that Sweden has resolved to take part in the international meteorological and magnetical observations in the Polar regions, and arrangements have been made for carrying on the observations from June 1, 1882, till June 1, 1883. The house erected at Masselbay in Spitzbergen by Nordenskjold's expedition, is still in good condition, and will be fitted up for the observatory. In connection with the Spitzbergen Observatory, Haparanda, at the head of the Gulf of Boothnia, is to be created into a first-class observatory, and furnished with Theorell's self-registering and printing meteorological apparatus, and all other observations will be made which are expected of a first-class observatory. M. Hjeltström is appointed director of the Haparanda Observatory. The funds to meet the expenses of the expedition and the two observatories have been most generously supplied by M. L. O. Smith, Stockholm. Prof. Hildebrandsson, the eminent Swedish meteorologist, has been entrusted with the discussion of the observations made by Prof. Nordenskjold on the celebrated *Vega* Expedition, to the publication of which meteorologists will look forward with the liveliest interest.

IN his fourteenth contribution to meteorology Prof. Loomis returns to the discussion of the interesting question of the course and velocity of storm centres in tropical regions. In a previous communication he had shown that in middle latitudes the average progress of storm centres corresponds pretty closely with the average direction of the prevailing wind of these latitudes. In marked contradistinction to this result is that now obtained regarding the course of the intertropical cyclones which occur within the region of the North-east Trade Winds. These cyclones, instead of following the ordinary course of the Trades towards the south-west, advance westward, but in a direction somewhat north of west.

DURING the winter months, storms while crossing the United States frequently advance during a part of their course from north-west to south-east. This course is followed most frequently in the region between the Rocky Mountains and the Mississippi, is seldom continued as far south as lat. 30°, and the storm centre, after reaching its most southerly point, often changes its course towards the north-east. Storms which cross the United States north of lat. 38° generally pursue a course a little to the north of east, while those which come from south of that latitude pursue a course nearly north-east. During the summer months however few storms travel south of lat. 38°, and during this part of the year the average course of storms is almost exactly towards the east.

PROF. LOOMIS next institutes a comparison between the West India hurricanes and those of the Bay of Bengal, China Sea, &c. The average course of the latter is towards the west, ranging from 13° south of west to 86° north of west, which agrees closely in this respect with the general course pursued by West India hurricanes. The velocity of their onward course is however markedly different, being only about eight miles per hour, which is less than half the average velocity of the West India cyclones. The average latitude when the course becomes north is nearly lat. 20°, being 10° more to southward than in the West Indies, and the velocity during this part of the course is only about nine miles an hour. Ultimately the cyclones curve round and pursue a course nearly east-north-east, with a velocity of onward movement scarcely reaching ten miles an hour, or less than half of the velocity found for West India hurricanes. Lastly, while in the West Indies cyclones or hurricanes have been found no farther south than lat. 10° N., in Southern Asia they have occurred as far south as lat. 6° N.

THE concluding part of the Contribution is taken up with an examination of those storms of middle latitudes which advance in a westerly direction. In these cases, which may be regarded as abnormal directions, it is found that the wind is generally greatest on the east side of the low centre of the storm. While there are thus on the east side of the low-pressure areas, causes tending to increase pressure on that side, there are different conditions on the west side tending to divert the winds westward, and this, Prof. Loomis thinks, is the most important reason why in such cases the storm centres advance to westward. In the United States, over the Atlantic, and in Europe, the influence of one area of low pressure upon another is a very common cause of abnormal movements of storm centres—such, for instance, as the coalescence of two low areas into one, resulting occasionally in an apparent westerly movement of the centre of lowest pressure.

THE "Results of Meteorological Observations made at Mauritius during 1877" fully sustains the high reputation of Dr. Meldrum's previous reports for fulness of detail, accuracy, and special observations not usually given in meteorological reports. The hourly monthly values have been calculated from the readings of the barograph for the year, and a valuable table is appended to this part of the report (p. 5), showing the mean monthly diurnal variation of atmospheric pressure for the three years 1875-77. The value of these results will be greatly enhanced when the thermograph which has been received has been got into working order. A comparison, a very satisfactory one, is made of the barograph readings with those of the standard barometer. As in 1876 the wind during 1877 attained its annual maximum velocity in the colder months from June to August, and its minimum in the warmer months, from November to March, and its diurnal maximum velocity from 11 a.m. to 2 p.m., and its minimum from about 2 to 5 a.m. The departures, however, from these times are such as to point to a considerable number of years' observations as required before the true average can be ascertained. Thirty one stations for recording the rainfall are now in working order, and in each case the annual amounts available from 1862 are printed, and the averages of the years given for each station. Mean temperatures for seven stations appear in the report, the three highest

stations, with the mean temperatures for 1877, being, Curepipe (1800 feet) 68°·3, Bonne Veine (1500 feet) 69°·5, and Midlands (1400 feet) 73°·2. The difference in height (400 feet) of the first and last of these, and the difference of their mean annual temperatures, 4°·9, call for inquiry, and in connection therewith it may be suggested that a small map showing the physical features of Mauritius and the positions of the various stations would usefully illustrate these reports. As regards thunderstorms, which are carefully recorded, none occurred from May to October during 1876 and 1877, and the daily maximum is from 1 to 4 p.m., with a tendency to a secondary maximum about sunset, and the daily minimum from 10 p.m. to a little after sunrise.

In a supplement to No. 366 of the *Bulletin International* of the Paris Observatory M. Mascart gives an interesting and rapid sketch of the meteorology of Europe for December last, illustrated with two maps showing the storm-tracks over the Continent during the month. During the first half of the month the storm-tracks were all to northward of the British Isles and Denmark, and fine weather prevailed particularly in Scotland, Denmark, and Germany. In France high barometers ruled with light winds, and temperatures high for the season. The contrast afforded with the weather in France during December, 1879, is is most striking; thus on December 10 of both years barometers were unusually high in France, but in 1880 the mean temperature was 50°·5, whereas on December 10, 1879, the mean temperature was $-14°·1$. The bearings of the geographical positions of anticyclones, with their high pressures, on the temperature of the regions covered by them is a point well worthy of examination. The influence of a high-pressure area resting over the Atlantic and extending on its eastern side over Western Europe, has doubtless a very different influence on the temperature of that part of the Continent than an area of high pressure covering the Continent and terminated on its west side by France and Spain, even though the barometer be equally high over the west of Europe. During the second half of December the storm-tracks took a much more southerly course, several being as far south as the Channel and the north shores of Germany. The result was an extension south of the cold, so that in Orkney and the Hebrides temperatures were nearly 3°·0 below the normal, on the Tweed about the normal, rising farther south to 1°·1 above the normal in North Wales, 5°·0 in the Channel Isles, and 6°·7 in Paris. During December, 1879, temperature in Paris was 21°·2 below the normal, the mean for that month being 17°·6, or 27°·9 colder than that of last December.

GEOGRAPHICAL NOTES

On Tuesday night, at the Royal Institution, Mr. Edward Wymper described his ascents of Chimborazo and Cotopaxi to a distinguished audience. While purely athletic mountaineers had his sympathy in the practice of mountaineering as a sport, Mr. Whymper confessed that his sympathies were much more with those who employed their brains as well as their muscles. His journey to the Andes was to be one of work, and all its arrangements were devised so as to economise time to the uttermost. In observations for altitudes and position, in studying the manners and customs of the country, in photography and sketching, in the collection of objects of interest, from beetles on the summits of mountains to antiquities buried in the ground, he found quite sufficient to occupy his time. From Bodegas the party was composed of two Swiss mountaineers, the cousins Carrel of Val Tournanche, Mr. Perring, some muleteers, and their teams. When they reached the summit of Chimborazo, on the 3rd of January, after a most arduous climb, they found the wind blowing at the rate of 50 miles an hour, from the north-east, and driving the snow before it. With extreme difficulty, a reading of the mercurial barometer was effected. The mercury fell to 14·1 inches with a temperature of 21 deg. Fahr. This being worked out, in comparison with a nearly simultaneous observation at Guayaquil, gave 20,545 feet for the height of Chimborazo. They began the descent at 20 minutes past 5, with scarcely an hour and a quarter of daylight, and reached their camp (about 17,400 feet above the sea-level) about 9 p.m., having been out nearly sixteen hours, and on foot the whole time. Passing from an extinct to an active volcano, Mr. Wymper next gave an account of his journey to the crater of Cotopaxi. Observing with the telescope, during an enforced stay at Machachi, that much less smoke or vapour was given off at night than by day, he resolved, if possible, to pass a night on the summit. On the 18th of February the party got to the edge of the crater, having passed almost the whole way from their camp at a height of 15,000 feet to the foot of the final cone over snow, and then over ash mixed with ice. The final cone was the steepest part of the ascent, and on their side presented an angle of 36 deg. When they reached the crater vast quantities of smoke and vapour were boiling up, and they could only see portions of the opposite side at intervals, and the bottom not at all. Their tent was pitched 250 feet from the edge of the crater, and during a violent squall the india-rubber floor of the tent was found to be on the point of melting, a *maximum* thermometer showing a temperature of 110 deg. on one side of the tent and of but 50 deg. on the other; in the middle it was 72·5 deg. Outside it was intensely cold, and a thermometer on the tent cord showed a *minimum* of 13 deg. At night they had a fine view of the crater, which has a diameter from north to south of 2000 feet, and from east to west of about 1500 feet. In the interior the walls descend to the bottom in a series of steps of precipice, and slope a good thousand feet, and at the bottom there was a nearly circular spot of glowing fire, 200 feet in diameter. On the sides of the interior higher up, fissures, from which flickering flames were leaping, showed that the lava was red hot a very short distance below the surface. The height he found to be 19,600 feet. The party remained at the top for twenty-six consecutive hours, sleeping about 130 feet below the loftiest point. At first they had felt the effects of the low pressure of the atmosphere, and again, as at Chimborazo, took chlorate of potash with good effect. All signs of mountain sickness had passed away before they commenced the descent, and did not recur during the journey. Nearly five months later Mr. Whymper returned to Chimborazo, and from a second reading of the barometer at 14·028 inches, with a temperature of 15 deg. Fahrenheit, he made the height 20,489 feet, the mean of the two readings giving 20,517 feet. While on the side of Chimborazo he witnessed a magnificent eruption of Cotopaxi, ashes rising in a column 20,000 feet above the rim of the crater and then spreading over an area of many miles. Prof. Bonney had submitted the ash to microscopic examination, and found that the fineness varied from 4000 to 25,000 particles to the grain in weight, and from observation of the area over which the ash fell Mr. Whymper calculated that at least two million tons must have been ejected in this one eruption.

A telegram was read at a recent meeting of the French Academy of Sciences from M. de Brazza, who has been conducting an exploration in the region of the Ogowe and Congo, West Africa. Quite recently a French station has been founded in the upper course of the former river in connection with the International African Association. In July last, M. de Brazza informs the Academy, he reached the Congo from this station on the Ogowé, between the river Inpaka Mpama and the river "Lawson Afrisi." Gaining the favour of King Makoko he pacified the tribes on the right bank of the Congo, and peacefully descended the river in a canoe. On October 3 he founded the station of Ntamo Ncoma on land ceded by King Makoko on the right bank of the Congo. M. de Brazza surveyed the route between the Ogowé and Congo; it is twelve marches in length, over a plateau of an average height of 800 metres. The country is healthy, and the population dense and peaceful. In November last M. de Brazza arrived at Mdambi Mbongo, the advanced post of Mr. Stanley, whom he met, and with whom he reached the latter's headquarters at Vivi on November 12. If the new station can be maintained and victualled, it is no doubt well chosen as a starting-point for further discovery, to both north and south of it there are large regions of which he knew nothing.

At the meeting of the Geographical Society on Monday last, Mr. E. Delmar Morgan gave some account of his journey last year to Semiretchia and the town of Kulja. Being unable to make use of the more southern line of communications, Mr. Morgan travelled by the northern post road from Orenburg to Troitsk and Petropaulofsk, and thence to Omsk and Semipalatinsk. He then struck southwards to Sergiopol, where he was detained three weeks owing to the southern road being blocked by snow. He afterwards went to Kulja for a short time, and he also made some excursions to Issyk-kul and other places of interest. In the course of the discussion which followed the paper, Mr. Ashton Dilke, the only other Englishman

who has visited Kulja, gave an interesting account of his experiences in that region a few years back

FEARS had been entertained by many that the expedition sent out by the Russian merchant M Alexander Sibiriakoff to discover the North Passage by means of the steamer *Oscar Dickson*, on board of which M. Sibiriakoff was himself, had been lost, and M. Konstantin Sibiriakoff, his brother, had already equipped another expedition to find and assist the *Oscar Dickson* In the meantime the welcome news has arrived that Alexander Sibiriakoff reached Tobolsk at the end of December. The *Oscar Dickson* and another ship, the *Nordland*, had met fresh ice near Mate-Ssale, and had retired into the Gydan Bay on the coast of Siberia, in order to winter there

M TARRY, a member of the French Commission for Trans-Saharan Communications, is stated to have discovered in the south of Wargla the ruins of a large city called Cedrada, which had been entombed by sands of the desert This city is placed in the Valley of Wed Mya, and in the vicinity of a number of sources which in former centuries watered thousands of palm-trees. Orders have been sent to procure a set of sounding apparatus, and it is expected a large quanity of pure water will be extracted from the earth. M Tarry published an appeal to the local papers in order to obtain from the Government the foundation of a colony in this remote region.

DEEP-SEA EXPLORATION[1]

II.

4 *FOOD* —The late Prof. Sars, in his remarks on the distribution of animals in the depths of the sea, asks "Whence do animals that live at depths far below the limits of vegetation obtain their food?" Bronn, Wallich, Wyville Thomson, and others have endeavoured to answer this question, but I do not think the problem has yet been satisfactorily solved A considerable quantity of vegetable food is undoubtedly supplied from the Sargasso Sea and a similar area in the Pacific Ocean, as well as by the sea weeds which fringe every coast. But this supply is not sufficient for the indirect support of the countless host of animals that inhabit the depths of the ocean, all of which are necessarily zoophagous or subsist on other animals Plant life, except perhaps one of a peculiar kind, which will be presently noticed, appears to be absent in depths exceeding 150 fathoms

In all probability the chief supply of vegetable food is derived from the countless diatoms, coccoliths, rhabdoliths, and oscillatoriæ, which are plants of a low degree of organisation, and swarm on the surface of the sea; these are swallowed by pelagic animals (such as *Salpæ* and Pteropods, or "sea-butterflies"), and the latter fall to the bottom after death, and form that flocculent or glairy mass which I have described in the Report of the *Porcupine* Expedition of 1869 as covering the bed of the North Atlantic at great depths.[2] The preservative effect of sea water on animal tissues would stay decomposition for a long while, and Mr. Moseley ascertained by a curious experiment that it would take only about four days for a *Salpa* to reach the bottom at a depth of 2000 fathoms, and that the *Salpa* was not greatly decomposed after having remained in sea-water for a month in the tropics.

When we say that vegetable life does not exist at any considerable depth, we must not forget that some kind is said to occur in great abundance even in the benthal or deepest zone The word "benthal" is applied to depths exceeding 1000 fathoms (see my Address, which is referred to hereafter in this lecture). Shells, corals, and other organisms, are everywhere permeated by what are considered to be minute plants allied to fungi or confervæ, which form branching canals, like those of the *Cliona* or perforating sponge, and such canals have been also detected in all fossiliferous strata of a marine nature, from the Silurian to the present epoch. These plants, or Thallophytes, have been called "parasitic"; but they do not live on any other living thing. They can hardly serve as food for deep-sea animals, because they are never exposed Whether they may not be a link to connect the animal and vegetable kingdoms may be a matter for further investigation.

Food is of course a very important factor as regards the size of all animals I have noticed, in my work on "British Conchology," that Mollusca from moderate depths are generally larger than those of the same species from shallow water; but this does not seem to be the case with a species of coral obtained in the *Challenger* Expedition, which ranged from a depth of 30 to one of 2900 fathoms, and was very variable in size

5 *Light.*—Milton tells us of the

"world of waters dark and deep."

One of the most interesting problems relating to the subject of this lecture is whether the above is a poetical idea or based on fact, as regards the absence of light in the abysses of the ocean

We do not know to what extent the sun's rays penetrate the sea, nor whether the bottom at all depths is absolutely devoid of light. An ingenious apparatus, which was contrived by Dr Siemens for ascertaining the presence of light at different depths by means of highly sensitive photographic paper, has never yet been properly tried. An experiment of this kind made by Prof. Forel proved that in the Lake of Geneva, even at a depth of only thirty fathoms, the paper was entirely unaffected after protracted exposure But the water of that lake is peculiar, it is said to be rendered less transparent by suspended and floating particles of mica brought from glacier streams, and to have thus acquired its deep blue colour I cannot believe that the only abyssal light, if there be any, is phosphorescent

At all events we are certain that, as regards the sea, many animals at very great depths have eyes, and that there is no absence of colour

Cuttlefishes, which have eyes not less highly organised than our own, have frequently been obtained from depths of many hundred fathoms, they do not eat phosphorescent polypes and such small deer. Nor are the deep-sea Mollusca blind. During the *Porcupine* Expedition of 1869 an undescribed species of *Pleurotroma* from 2090 fathoms had a pair of well-developed eyes on short footstalks, and a *Fusus* from 1207 fathoms had its eyes at the base of the tentacles The last-named mollusks chiefly prey on bivalves I have taken at moderate depths, living on the same ground, closely allied species of univalve mollusks, some of which were eyeless or blind, and others were provided with the usual organs of vision Numerous instances have been given by the *Challenger* naturalists of apparently seeing as well as of apparently sightless animals taken at great depths. Prof Semper, of Wurzburg, says, in "The Natural Conditions of Existence as they Affect Animal Life" (1881), "Many creatures furnished with well-constructed eyes live associated with the actually blind species, and which have been partly enumerated above" He mentions among the former five species of fish (one of a new genus) discovered in the *Challenger* Expedition at depths of from 675 to 2040 fathoms, besides several Mollusca and Crustacea.

Some land-slugs and mollusks (e g *Geomalacus maculosus* and *Achatina acicula*) are also blind On the sea-shore and in shallow water most bivalves, as well as all the species of *Chiton*, are eyeless.

Some deep-sea animals are brightly and deeply-coloured. In the *Challenger* Expedition shrimps "of an intense bright scarlet colour" were obtained in very great abundance, and many Holothurians or sea cucumbers were of a "deep purple" hue. The same observation occurred to me in the *Porcupine* and *Travailleur* Expeditions

6. *Temperature*—The highest temperature of the sea-bottom observed in the *Challenger* voyage at depths over 1000 fathoms was 50°·5 Fahr., in 2550 fathoms; the lowest was 32°·1 only, in 1950 fathoms. The average bottom-temperature at great depths does not much exceed the freezing-point, but life does not appear to be affected by that circumstance In the Arctic Expedition of 1875 I found an abundance and variety of animals in icy cold water.

7. *Depth.*—The average depth of the ocean between latitudes 60° N. and 60° S is nearly three miles, or 2500 fathoms. The greatest depth which has been ascertained by sounding is five miles and a quarter, or 4620 fathoms, and occurs in the North west Pacific Ocean; it is nearly equal to the height of Mount Everest, the highest known mountain, in the proportion of 27,720 to 29,000 feet.

8. *Inequalities of the Sea-bottom.*—The operations of the Telegraph Construction and Maintenance Company have materially added to our knowledge of the shape and contour of the floor of the ocean They have shown us that the bed of the sea is quite as uneven as the surface of the land, and that it represents the same mountains, hills, gorges, and valleys, equally

[1] A Lecture by J Gwyn Jeffreys, LL.D., F R.S Given at Swansea, Llanelly, and Barrow-in-Furness, in December 1880 and January 1881 Continued from p 302

[2] See *Proc* Roy Soc. 1870, p 420.

diversified in the one case by oceanic currents on the surface as well as on the bottom, and in the other by foaming rivers and gentle streams. I will give a few instances of such inequalities in the North Atlantic. While repairing in 1878 the Anglo-American Cable, a tract of rocky ground was discovered, about 100 miles in length, in the middle of the North Atlantic, between 33° 50′ and 36° 30′ West longitude, and about 51° 20′ North latitude. Within a distance of eight miles the shallowest sounding was 1370, and the deepest 2230 fathoms, a difference of 860 fathoms, or 5160 feet; within four miles the difference was 3180 feet, and within half a mile 1380 feet. There are also the Laura Ethel Bank, with a depth of only 36 fathoms, and the Milne Bank, with 81 fathoms, both about 550 miles from Newfoundland, which is the nearest continental land. Other instances are the Josephine Bank, with 82 fathoms, and Gettysburg Bank, with 30 fathoms, the distance of the former from Cape St. Vincent being 250, and the latter 130 miles, with intermediate depths of from 1700 to 2500 fathoms. The soundings in the *Bulldog* Expedition also gave 748 between 1168 and 1260 fathoms, and the *Valorous* soundings gave 690 between 1450 and 1230 fathoms in another part of the North Atlantic and very far from any land.

A glance at the large series of diagrams of the *Challenger* soundings will at once serve to convince one of the extreme unevenness of the sea-bottom everywhere in the Atlantic and Pacific oceans. It would be difficult to find a greater degree of unevenness in any diagrams of the earth's surface, the total extent of which scarcely exceeds one fourth of that of the sea.

Diagrams to illustrate the inequalities of the sea-bottom in the case of the telegraph cable, and the irregularities of level in a similar extent of land in the Perthshire Highlands, are placed before you.

9. *Deposits*.—The floor of the ocean is covered by a more or less thick layer of ooze or mud, and of clays of different sorts and colours, which is inhabited by various animals. One of these deposits is called "*Globigerina*"-ooze, and is widely distributed over the bed of both the Atlantic and the Pacific. Another deposit is called "Red Clay," and is found at depths exceeding 2000 fathoms. Mr. Murray, one of the *Challenger* naturalists, has carefully worked out the deep sea deposits which were observed and collected during the expedition. According to him the *Globigerina*-ooze occurred in the North Atlantic at forty-nine stations, from depths between 780 and 2675 fathoms; in the South Atlantic at six stations, from depths of between 1375 and 2150 fathoms; and in the Pacific Ocean at twenty-two stations, from depths of between 275 and 2925 fathoms. He also mentions other deposits, viz. Coral-mud, Radiolarian ooze, and Diatomaceous ooze. Mr. Murray also says that volcanic products, such as pumice, lava, and scoriæ, as well as the peroxide of manganese, are universally spread over the bottom of the deep sea; and, in consequence of copper, cobalt, and nickel having been detected in the clays, he was tempted to suggest the presence of meteoric or cosmic dust in those deposits.

An animated, but quite amicable, controversy has of late years taken place as to whether *Globigerina* (from which the first-mentioned ooze has taken its name) lives only on the bottom or on the surface of the sea, or on both of them. You will doubtless ask, What is a *Globigerina*? It is a microscopic shell, consisting of a few globular cells, which are added together in the course of growth, the smallest cell being the original one or nucleus, and the largest being the last formed. All the cells are full of a protoplasmic substance called sarcode, which is amorphous or has no definite structure—no head, no limbs, no heart, viscera, muscles, or nerves. Its entire body is a stomach, and nothing but a stomach. The same kind of sarcode forms the living pulp of sponges, which have a horny or glass-like skeleton instead of a shell. The *Globigerina* is a member of an extensive and extremely variable class of invertebrate animals called Foraminifera; and this class, as well as sponges, belong to a kingdom called Protozoa, the name of which imports not that it was the earliest form of life, but that its organisation is of the very primary or simplest kind. The cells of the *Globigerina* are in their living state covered with the most delicate spines of comparatively great length, which are set outwards, and probably serve to keep at a respectful distance all predatory animals of an equally minute size. Between these spines some of the sarcode is occasionally, if not habitually, protruded at the will of the animal through very fine pores of the shell, which gave rise to the name Foraminifera. Such prolongations or expansions of the sarcode are called pseudopodia, and are used for capturing and taking into the body or stomach animal or vegetable particles which serve for food, and are engulfed in the internal sarcode. Having premised thus much, and in the hope that my description may be tolerably intelligible to those who have not, like myself, studied the Foraminifera, I will proceed with my account of the controversy. I have frequently taken with a towing-net on the surface of the sea a multitude of floating *Globigerinæ*, which were certainly alive and showed their pseudopodia as well as their long and thick-set spines. Major Owen and Lieut. Palmer, who especially studied the surface-fauna of the Atlantic, observed and have published the same facts.[1] Therefore when, in the joint report of my colleagues and myself to the Royal Society, on the results of the first *Porcupine* Expedition in 1869, it was stated or strongly inferred that the *Globigerinæ* really "inhabit the bottom on which they are found in such extraordinary abundance," and that the hypothesis accounting for such accumulation by their having fallen to the bottom after death, their lives having been passed at or near the surface, was conclusively disproved, I ventured to record my dissent from that conclusion. The observations of Mr. Murray, one of the naturalists in the *Challenger* Expedition, have fully confirmed the hypothesis that *Globigerina* lives on the surface; and Sir Wyville Thomson now admits[2] it as an established fact. But Dr. Carpenter is not satisfied. He is of opinion that "whilst the *Globigerinæ* are pelagic in an earlier stage of their lives, frequenting the upper stratum of the ocean, they sink to the bottom *whilst still living*, in consequence of the increasing thickness of their calcareous shells, and not only continue to *live* on the sea-bed, but probably *multiply* there—perhaps there exclusively."[3] I must say that I am not convinced by the instances and arguments which he adduced in support of his opinion. There is no question that a great many species of Foraminifera live always on the sea-bottom; but I do not know that any species of pelagic or surface-dwelling animal inhabits also the sea bottom. Dr. Wallich found that the stomachs of star-fishes which came up with the sounding-line from 1260 fathoms contained fresh-looking *Globigerinæ*, and that the latter were full of sarcode. This does not prove much, because sea water is to some extent antiseptic or retards putrefaction. Many star fishes feed like earthworms, and swallow quantities of organic and inorganic matter for the purpose of extracting nutriment from it. Sir Wyville Thomson says, in his paper "On Dredgings and Deep-Sea Soundings in the South Atlantic" (*Proc.* R. S. vol. xxii. p. 427), that the appearance of *Globigerina* and certain other Foraminifera, "when living on the surface, is so totally different from that of the shells at the bottom that it is impossible to doubt that the latter, even although they frequently contain organic matter, are all dead." Mr. Murray adds (*Proc.* R. S. vol. xxvi. p. 535):—"No living specimen of a *Globigerina*, an *Orbulina*, a *Pulvinulina*, or of the new genera found on the surface, which undoubtedly came from the bottom, has yet been met with. The foregoing observations appear to justify the opinion that these organisms live only in the surface and subsurface waters of the ocean."

I will not however presume to assert that Dr. Carpenter may not be right; but is he justified in taking for granted "that the *onus probandi* rests on those who maintain that the *Globigerinæ* do *not* live on the bottom"? It is rather difficult to prove such a negative.

The colour of the "Red Clay" was attributed by Mr. Murray to the presence of oxide of iron.

Mr. Etheridge obligingly examined some of the pebbles and minerals which I had dredged in the *Valorous* Expedition at depths of from 690 to 1750 fathoms. He reported that many of them were "most likely derived from Iceland." If this were the case, the pebbles and minerals might have been transported by a deep submarine current.

The deposits in very deep water, and beyond the range of fluviatile and tidal action, are so slight as to be almost filmy, and are chiefly composed of the skeletons or hard parts of *Globigerinæ*, Diatoms, and *Radiolariæ*. The subjacent layer of mud or ooze, where it is beyond the scope of river action, may have been formed from the ruins of a sunken continent.

The proportion of carbonate of lime contained in the deep-sea mud or ooze of the North Atlantic, which was procured in the first two cruises of the *Porcupine* Expedition of 1869, slightly differed. In a sample from 1443 fathoms, dredged off the west

[1] *Journal* of the Linnean Society, vol. ix. p. 147.
[2] *Proc.* Roy. Soc. vol. xxiii. p. 34.
[3] *Ibid.* p. 235.

coast of Ireland in the first cruise, the proportion given by the late Mr David Forbes was only about one-half, while in another sample from 2435 fathoms, dredged off the south coast of Ireland in the second cruise, Mr. Hunter found a little over 60 per cent.

As to a mysterious deposit called *Bathybius*, Mr Buchanan, who had charge of the chemical work on board the *Challenger*, proved by careful and repeated analysis that this substance was not organic; and he "determined it to be sulphate of lime, which had been eliminated from the sea-water, always present in the mud, as an amorphous precipitate on the addition of spirit of wine." Mr Murray came to the same conclusion, and the lifeless and inorganic nature of *Bathybius* may now be considered settled. This gelatinous slime was once imagined to be primordial, and to constitute the basis of life But the sea-bed is the tomb of past generations, not the womb of creation.

10. *Geological.*—The late Sir Charles Lyell says, in the sixth edition of his "Elements of Geology" (1865), "that white chalk is now forming in the depths of the ocean, may now be regarded as an ascertained fact, because the *Globigerina bulloides* is specifically undistinguishable from a fossil which constitutes a large part of the chalk of Europe." He assumed that the *Globigerina* inhabited the ooze on the sea-bed. Edward Forbes and other geologists had initiated and adopted the same view that Chalk was a deep-sea deposit. In my Presidential Address to the Biological Section of the British Association at the Plymouth Meeting in 1877, I ventured to question the validity of this theory, and especially that which my colleague and friend Sir Wyville Thomson started as to the "continuity of the Chalk" from the Cretaceous to the present period. I there endeavoured to show that the Chalk differed in composition from the Atlantic mud, and that the fauna of the Chalk formation represented shallow and not deep water. My view has, I am glad to say, been to some extent admitted by Sir Wyville Thomson in his "Report on the Scientific Results of the Voyage of H M S. *Challenger*," when he speaks (pp. 49 and 50) of the belt of "shallower water" during the Cretaceous period At all events, Mr. Wallace has lately accepted and confirmed my opinion[1] It is highly probable that the Gault, which underlies the Chalk and is the lowest member of the Upper Cretaceous formation, was a deep-water deposit, because it abounds in small shells of the *Arca* and *Corbula* families, which are wanting in the Chalk, as well as in Ammonites and other free-swimming Cephalopods

Mr. Sollas, indeed, in his paper "On the Flint Nodules of the Trimmingham Chalk" (*Annals and Magazine of Natural History* for December, 1880) believes that some deep-sea mud is analogous with the Chalk He is aware that the former contains siliceous organisms and the latter none, and he supposes that the flints had been in some way derived from these organisms But how flints originated and were formed is still a vexed question. Mr Sollas is perhaps our best authority on Sponges, but he states (p 444) that "the bottom-water of the sea is remarkably free from organic matter" This statement does not agree with the analyses of the bottom-water of the sea which were made by Mr. Lant Carpenter, Dr. Frankland, and Mr. Buchanan, the chemist of the *Challenger*, nor with the observations of Sir Wyville Thomson in his "Depths of the Sea," in which he says (p. 46) "the bottom of the sea is a mass of animal life"

Several species of Mollusca which were previously known as fossil only, and were supposed to be extinct, have lately been dredged by myself and others from the bottom of the Atlantic Some of these same species had been described and figured by Prof. Seguenza of Messina from Pliocene beds in Sicily. I have no doubt that many more, perhaps all, of such fossil species will be hereafter discovered in a living state by means of deep-sea explorations.

Some geologists, and especially of late years, have advocated the theory that oceans have continued for an enormously long period to occupy the same areas that they still occupy Mr Darwin was, I believe, the first to broach this idea He says, in the chapter "On the Imperfection of the Geological Record," "We may infer that where our oceans now extend oceans have extended from the remotest period of which we have any record; and, on the other hand, that where continents now exist large tracts of land have existed, subjected, no doubt, to great oscillations of level, since the earliest Silurian period." There does not seem to be any fact adduced or reason given for either of the above inferences.

[1] "Island Life."

If the present oceans and continents have remained unchanged since the Silurian period, how can we account for the wide-spread distribution of fossiliferous formations, Palæozoic, Mesozoic, Cainozoic or Tertiary, and Quaternary or Recent, miles in thickness, all over Europe, Asia, Africa, Australasia, and New Zealand? All oceanic islands are of volcanic origin, but some of them contain Miocene fossils. These formations are chiefly marine, both deep water and shallow; and they necessarily imply the presence of oceans in those parts of the globe which are now continents and dry land All the "secrets of the deep" will probably never be revealed to man, nor is he likely to know what terrestrial formations underlie the floor of the mid ocean

In my paper "On the Occurrence of Marine Shells of Existing Species at different Heights above the Present Level of the Sea," which was published in the *Quarterly Journal of the Geological Society* for August 1880, I stated that many existing species of Mollusca which inhabit great depths only are found in a fossil state at considerable heights above the present level of the sea, so as to show an elevation equal to nearly 12,000 feet, and that such elevation must have taken place at a very late and comparatively recent stage of the Tertiary or Post-Tertiary epoch. In the face of facts like this, can we rightly assign to the present oceans that geologically remote antiquity which is claimed for them?

11. *Incidental*—Clarence's dream of wrecks, corpses, wonderful treasures, and

> reflected gems
> That woo'd the slimy bottom of the deep,
> And mock'd the dead bones that lay scatter'd by"

has not yet, I believe, been realised by any dredger. I have in this way explored for between forty and fifty years all our own seas, besides a considerable part of those on the coasts of North America, Greenland, Norway, France, Spain, Portugal, Morocco, and Italy, but I have never found anything of value except to a naturalist, nor any human bone, although many thousand human beings must have perished in those seas

12 *Concluding Remarks.*—To give a better idea of the ocean and of its life in the depths as well as on the surface, let me strongly recommend my hearers to read Mr Moseley's admirable volume entitled "Notes of a Naturalist on the *Challenger*." His graphic account of this marvellous voyage far surpasses in interest (to say nothing of accuracy) every work of fiction or imagination, and it has not the melancholy dulness of most books on history and travels.

The subject of this lecture is inexhaustible; and, as our knowledge of it becomes more extended, we must continually say with Seneca, "Our predecessors have done much, but have not finished. Much work yet remains, and much will remain; nor to any one, born after a thousand ages, will be wanting the opportunity of still adding something." Such increase of knowledge must tend to confirm our acknowledgment, with a reverential awe, of that Great Creator whose wondrous works are dimly seen in every form of life, marine and terrestrial, and especially in

> "all that glides
> Beneath the wave, yea, in the wave itself,
> And mighty waste of waters"

GAS AND ELECTRICITY AS HEATING AGENTS[1]

I.

ON March 14, 1878, I had the honour of addressing you "On the Utilisation of Heat and other Natural Forces." I then showed that the different forms of energy which Nature has provided for our uses had their origin, with the single exception of the tidal wave, in solar radiation; that the forces of wind and water, of heat and electricity, were attributable to this source, and that coal formed only a seeming and not a real exception to the rule,—being the embodiment of a fractional portion of the solar energy of former geological ages.

On the present occasion I wish to confine myself to one branch only of the general subject, namely, the production of heat energy. I shall endeavour to prove that for all ordinary purposes of heating and melting, gaseous fuel should be resorted to for the double reason of producing the utmost economy and of doing away with the bugbear of the present day, the smoke nuisance, but that for the attainment of extreme degrees of heat

[1] A lecture by C William Siemens, D C L, LL D, F.R S, on January 27, in St Andrew's Hall, Glasgow, under the auspices of the Glasgow Science Lecture Association.

the electric arc possesses advantages unrivalled by any other known source of heat

Carbonaceous material such as as coal or wood is practically inert to oxygen at ordinary temperatures; but if wood is heated to 295° C. (593° F), or coal to 326° C. (617° F), according to experiments by M. Marbach, combination takes place between the fuel and the oxygen of the atmosphere, giving rise to the phenomenon of combustion. It is not necessary to raise the whole of the combustible materials to this temperature in order to continue the action, the very act of combustion when once commenced gives rise to a great development of heat, more than sufficient to prepare additional carbonaceous matter, and additional air for entering into combination, thus a match suffices to ignite a shaving, and that in its turn to set fire to a building.

The first effect of combustion is therefore to heat the combustible and the air necessary to sustain combustion to the temperature of ignition, but in dealing with the combustible called coal other preparatory work has to be accomplished besides mere heating in order to sustain combustion The following is an analysis from Dr Percy's work on "Fuel" of a coal from the Newcastle district —

Carbon	81 41	Nitrogen	2 05
Hydrogen	5 83	Sulphur	0 74
Oxygen	7·90	Ash	2·07

which shows at a glance that nearly 16 per cent of the total weight consists of such permanent gases as hydrogen, oxygen, and nitrogen These gases are partly occluded or absorbed within the coal, but are also combined with carbon-forming volatile compounds, such as the hydrocarbons and ammonia, so that when coal is subjected to heat in a closed retort, as much as 35 per cent. passes away from the retort in a gaseous condition and as vapour of water, partly to condense again in the form of tar, and of ammoniacal liquor, and partly to pass into the gas mains as illuminating gas, a mixture mainly of marsh gas (CH_4), olefiant gas (C_2H_4), and acetylene (C_2H_2), its value as an illuminant depending upon the percentage of the last two constituents rich in carbon. The result of the distillation of a ton of coal will be as follows, from data with which Mr A. Upward has kindly supplied me —

	cwt
Coke	13 60
Tar	1 20
Ammoniacal Liquor	1 45
Gas	3 15
Carbonic acid	0·18
Sulphur removed by purifying	0 30
Loss .	0 12

So great is the loss of heat sustained in an ordinary coal fire, in consequence of the internal work of volatilisation, that such a fire is scarcely applicable for the production of intense degrees of heat, and it has been found necessary to deprive the coal in the first place of its volatile constituents (to convert it into coke) in order to make it suitable for the blast furnace, for steel melting, and for many other purposes where a clear intense heat is required.

In the ordinary coke oven the whole of the volatile constituents are lost, and each 100 lbs of coal yield only 66 lbs of coke, including the whole of the earthy constituents which on a large average may be taken at 6 lbs, leaving a balance of 60 lbs of solid carbon In burning these 60 lbs. of pure carbon, 220 lbs. of carbonic anhydride (CO_2) are produced, and in this combination $60 \times 14{,}500 = 870{,}000$ heat units (according to accurate determinations by Favre and Silbermann, Dulong, and Andrews) are produced

The 34 per cent. of volatile matter driven off yield, when the condensible vapours of water, ammonia, and tar are separated, about 16 lbs. of pure combustible gas (being equal to about 10,000 cubic feet per ton of coal), which in combustion produce $16 \times 22{,}000 = 352{,}000$ heat units The escape of these gases from the coke oven constitutes a very serious loss, which may be saved, to a great extent at least, if the decarburisation is effected in retorts. The total heat producible from each 100 lbs of coal is in that case $870{,}000 + 352{,}000 = 1{,}222{,}000$ or 12,220 units per lb. of coal Deduction must, however, be made from this for the heat required to volatilise 34 lbs of volatile matter for every 100 lbs. of coal used, and also for heating the coke to redness, or say to 1000° F. Considering the multiplicity of gases and vapours produced it would be tedious to give the details of this calculation, the result of which would approximate to 60,000 heat units, or 600 units per lb of coal treated

We thus arrive at $12{,}200 - 600 = 11{,}600$ heat units as the maximum result to be obtained from 1 lb of best coal. Considering, however, that the coal commonly used for industrial purposes contains more ashes and more water than has been here assumed, a reduction of say 10 per cent. is necessary, and the calorific power of ordinary coal may fairly be taken at 10,500 units per. lb.

In applying this standard of efficiency to actual practice it will be found that the margin for improvement is large indeed Thus in our best steam-engine practice we obtain one actual HP. with an expenditure of 2 lbs of coal per hour (the best results on record being 1·5 lb. of coal per Indicated HP) A HP. represents $33{,}000 \times 60 = 1{,}980{,}000$ foot-lbs. per hour, which is $\frac{1{,}980{,}000}{2} = 990{,}000$ foot lbs, or units of force, per lb. of fuel. Dr Joule has shown us that 772 foot-lbs represent one unit of heat, and 1 lb of coal therefore produces $\frac{990{,}000}{772} = 1282$ units of heat instead of 10,500, or only one-eighth part of the utmost possible result

In melting steel in pots in the old-fashioned way, as still practised largely at Sheffield, 2½ tons of best Durham coke are consumed per ton of cast steel produced. The latent and sensible heat really absorbed in a pound of steel in the operation, does not exceed 1800 units, whereas 2½ lbs of coke are capable of producing $13{,}050 \times 2\ 5 = 32{,}625$ units, or 18 times the amount actually utilised.

In domestic economy the waste of fuel is also exceedingly great, but it is not easy to give precise figures representing the loss of effect, owing to the manifold purposes to be accomplished, including cooking and the heating and ventilation of apartments If ventilation could be neglected, close stoves such as are used in Russia would unquestionably furnish the most economical mode of heating our apartments, but health and comfort are after all of greater importance than economy, and these are best secured by means of an open chimney. Not only does the open chimney give rise to an active circulation of air through the room, which is a necessity for our well-being, but heat is supplied to the room by radiation from the incandescent material instead of by conduction from stove surfaces, in the one case the walls and furniture of the room absorb the luminous heat rays, and yield them back to the transparent air, whereas, in the latter case, the air is the first recipient of the stove heat, and the walls of the room remain comparatively cold and damp, giving rise to an unpleasant musty atmosphere, and to dry rot or other mouldy growth. The adversaries of the open fireplace say that it warms you on only one side, but this one-sided radiant heat produces upon the denizens of this somewhat humid country, and indeed upon all unprejudiced people, a particularly agreeable sensation; which is proof I think of its healthful influence. The hot radiant fire imitates indeed the sun in its effect on man and matter, and before discarding it on the score of wastefulness and smokiness, we should try hard, I think, to cure it of its admitted imperfections

If incandescent coke is the main source of radiant heat, why, it may be asked, do we not resort at once to coke for our domestic fuel? The reasons are twofold the coke would be most difficult to light, and when lighted would look cheerless without the lively flickering flame

The true solution consists, I venture to submit, in the combination of solid and gaseous fuel when brought thoroughly under control, by first separating these two constituents of coal. I am bold enough to go so far as to say that raw coal should not be used as fuel for any purpose whatsoever, and that the first step toward the judicious and economic production of heat is the gas retort or gas producer, in which coal is converted either entirely into gas, or into gas and coke, as is the case at our ordinary gas works

When in the early part of the present winter London was visited by one of its densest fogs, many minds were directed towards finding a remedy for such a state of things. In my own case it has resulted in an arrangement which has met with a considerable amount of favour and practical success, and I do not hesitate to recommend it to you also for adoption. Its general application would, as regards dwelling-houses, make our town atmosphere as clear as that of the surrounding country. If it can be shown that the arrangement may be easily and

cheaply applied, that it will relieve our housemaids of the most irksome portion of their daily work in laying fires and cleaning grates, and that a warm and cheerful fire can be made at a considerably cheaper rate than when using coal, you will admit, I hope, that the proposal is worthy of a trial.

In outward appearance my fire-grate, which I have not made the subject of a patent, and which may therefore be put up by any grate or gas-fitter without restraint, is very similar to the ordinary coal-grate, the latter may indeed be converted into the smokeless grate at a very trifling cost The essential features of this grate are that solid carbonaceous fuel, such as coke or anthracite, are used in combination with as much gas as is found necessary to raise the former to the point of incandescence, that the combustion is entirely confined to the front of the grate, whence radiation into the room takes place, and that any heat reaching the back of the grate is conducted away and utilised in heating the incoming air, by which combustion in front of grate is supported, in this way greater brilliancy and considerable economy are realised

One arrangement by which this is effected is represented in diagram 1 (see NATURE, vol xxiii. p. 26). The iron dead plate *c* is riveted to a stout copper plate *a* facing the back of the fire grate, and extending five inches both upwards and downwards from the point of junction. The dead plate *c* stops short about an inch behind the bottom bar of the grate to make room for a half-inch gas-pipe *f*, which is perforated with holes of about one-sixteenth of an inch placed at distances of one and a half inch along the inner side of its upper surface. This pipe rests upon a lower plate *d*, which is bent downwards towards the back so as to provide a vertical and horizontal channel of about one inch in breadth between the two plates. A trap-door *e*, held up by a spring, is provided for the discharge of ashes falling into this channel. The vertical portion of this channel is occupied by a strip of sheet copper about four inches deep, bent in and out like a lady's frill and riveted to the copper back piece Copper being an excellent conductor of heat, and this piece presenting (if not less than a quarter of an inch thick) a considerable sectional conductive area, transfers the heat from the back of the grate to the frill-work in the vertical channel. An air current is set up by this heat, which, in passing along the horizontal channel, impinges on the line of gas flames and greatly increases their brilliancy So great is the heat imparted to the air by this simple arrangement that a piece of lead of about half a pound in weight introduced through the trap-door into this channel melted in five minutes, proving a temperature exceeding 619° F or 326° C The abstraction of heat from the back has moreover the advantage of retarding the combustion of the coke there while promoting it at the front of the grate.

The sketch represents a fire-place at my office, in a room of 7200 cubic feet capacity facing the north I always found it difficult during cold weather to keep this room at 60° F with a coal fire, but it has been easily maintained at that temperature since the grate has been altered to the gas-coke grate just described.

In order to test the question of economy, I have passed the gas consumed in the grate through a Parkinson's 10-light dry gas meter, the coke used is also carefully weighed

The result of one day's campaign of nine hours is a consumption of 62 cubic feet of gas and 22 lbs of coke (the coke remaining in the grate being in each case put to the debit of the following day) Taking the gas at the average London price of 3*s* 6*d*. per 1000 cubic feet, and the coke at 18*s*. a ton, the account stands thus for nine hours —

	d
62 cubic feet of gas at 3*s*. 6*d* per thousand	2 604
22 lbs coke at 18*s*. a ton .	2·121
Total	4 725

or at the rate of 0 525*d* per hour. In its former condition as a coal-grate the consumption exceeded generally two and a half large scuttles a day, weighing 19 lbs. each, or 47 lbs of coal, which at 23*s*. a ton equals 5 7*d*. for nine hours, being 0·633*d* per hour This result shows that the coke-gas fire, as here described, is not only a warmer but a cheaper fire than its predecessor, with the advantages in its favour that it is lit without the trouble of laying the fire, as it is called, and keeps alight without requiring to be stirred, that it is thoroughly smokeless, and that the gas can be put off or on at any moment, which in most cases means considerable economy.

A second and more economical arrangement as regards first cost is shown in diagram 2 (NATURE, vol xxiii, pp. 92, 93), and consists of two parts, which are simply added to the existing grate, viz. (1) the gaspipe *d* with a single row of holes of about $\frac{1}{16}$ inch diameter, 1 5 inch apart along the upper side inclining inward, and (2) an angular plate *a*, of cast iron, with projecting ribs *b*, extending from front to back on its under side, presenting a considerable surface, and serving the purpose of providing the heating surface produced by the copper plate and frill-work in my first arrangement In using iron instead of copper it is necessary however to increase the thickness of these plates and ribs in the inverse ratio of the conductivity of the two metals, or as regards the back plate, from ¼ inch to $\frac{4}{5}$ inch according to the best determinations recently published by Sir W Thomson. This thickness would be practically inconvenient, and in order to avoid it the construction of the grate had to be modified for cast iron.

An inclined plate fastened to the lower grate bar directs the incoming air upon the heating surfaces and provides at the same time a support for the angular and ribbed plate, which is simply dropped into its firm position between it and the back of the grate.

The front edge of the horizontal plate has vandyked openings *c*, forming a narrow grating, through which the small quantity of ashes that will be produced by combustion of the coke or anthracite in the front part of the grate discharge themselves down the incline towards the back of the hearth, where an open ash-pan may be placed for their reception.

In adapting the arrangement to existing grates, the ordinary grating may be retained to support the angular plate, which has in that case its lower ribs cut short, to the level of the horizontal grate

But it may be asked, Are you sure that the coke and gas grate you advocate will do away with fogs and smoke? My answer is, that it would certainly do away with smoke, because the products of combustion passing away into the chimney are perfectly transparent Mr. Aitken has, however, lately proved in an interesting paper read before the Royal Society of Edinburgh, that even with perfect combustion a microscopic dust is sent up into the atmosphere, each particle of which may form a molecule of fog We have evidence, indeed, that the whole universe is filled with dust, and this is, according to Prof. Tyndall, a fortunate circumstance, for without dust we should not have a blue, but a pitch-black sky, and on our earth we should be, according to Mr. Aitken, without rain, and should have to live in a perpetual vapour bath The gas fires would contribute, it appears, to this invisible dust, and we should, no doubt, continue to have fogs, but these would be white fogs, which would not choke and blacken us It is not clearly shown what this fine dust, resulting from the combustion of gas, consists of, and it seems reasonable to suppose that in perfect combustion it will be avoided

Granted the cure of smoke, it might still be questioned whether such a plan as here proposed could be carried out on so large a scale as to affect our atmosphere with the existing mains and other plant of the gasworks If gas were to be depended upon entirely for the production of the necessary heat, as is the case with an ordinary gas and asbestos grate, it could easily be proved that the existing gas mains would not go far to supply the demand, each grate would consume from 50 to 100 cubic feet an hour, representing in each house a consumption exceeding many times the supply to the gaslights. My experiments prove, however, that an average consumption of from 6 to 8 cubic feet of gas per hour suffices to work a coke gas grate on the plan here proposed This is about the consumption of a large Argand burner, and therefore within the limits of ordinary supply

But independently of the practical question of supply, it is desirable on the score of economy to rely upon the solid carbon chiefly for the production of radiant heat for the following reason —

1000 cubic feet of ordinary illuminating gas weigh 34 lbs., and the heat developed in their combustion amounts to $34 \times 22{,}000 = 748{,}000$ heat units.

One pound of solid coke develops in combustion, say, 13,400 heat units (assuming 8 per cent. of incombustible admixture), and it requires $\frac{748{,}000}{13{,}400} = 56$ lbs., or just half a hundredweight, of this coke to produce the same heating effect as 1000 cubic feet of gas. But 1000 cubic feet of gas cost on an average

3*s* 6*d.* and half a hundredweight of coke not more than 6*d* (at 20*s* a ton), or only one-seventh part of the price of gas

If heating gas was supplied at a much cheaper rate, it would in many cases be advantageous to substitute incombustible matter, such as balls of asbestos, for the coke or anthracite. The consumption of gas would in that case have to be increased very considerably, but the economical principle involved (that of heating the air of combustion by conduction from the back of the grate) would still apply, and produce economical results as compared with those obtained by the gas-asbestos arrangements hitherto used.

To illustrate the efficiency of this mode of heating the in-coming air by what is called waste heat, I will show you another application of the same principle which I have made very recently to the combustion of gas for illuminating purposes.

(*To be continued.*)

THE RECENT SEVERE WEATHER

IN a recent contribution to the literature of meteorology Mr E J. Lowe, F.R.S., endeavours to prove that droughts and great frosts are periodical, occurring at intervals of between eleven and twelve years. In support of this theory he remarks "There can be no reasonable doubt that the cycles are more than eleven years and less than twelve (more nearly eleven than twelve)," and a table of "great frosts" is given, from which we take the dates for the present century in the same order as printed

1801—2	1819—20	1860—61
1813—14	1837—38	1856—57
1810—11	1840—41	1870—71

The present year may now be added to the above list

It will be noticed that there are some variations in the lengths of the intervening periods, but there is at the same time a distinct recurrence of eleven-year epochs

The great frost of the month just ended will doubtless form one of the main features in the meteorology of the nineteenth century In the table below are given the average temperatures of the United Kingdom for the three weeks ended January 10, 17, and 24 of the present year, together with the temperatures for the same weeks ended January 12, 19, and 26 of the year 1880 Each year the average for these periods was below the mean seasonal value The deficiency is given in the fifth and tenth columns

Districts	1881 1st week	1881 2nd week	1881 3rd week	1881 Average	Below the mean	1880 1st week	1880 2nd week	1880 3rd week	1880 Average	Below the mean
	°	°	°	°	°	°	°	°	°	°
Scotland East	30	24	25	26·3	11·7	18	34	34	35·1	2·3
England N E	35	23	25	27·7	9·7	37	32	32	33·7	4·3
England East	36	23	24	27·7	10·7	31	34	31	32·3	6·0
Midland Counties	34	21	22	25·7	13·3	35	33	29	32·0	6·7
England, South.	37	26	26	29·7	10·3	35	32	30	32·3	7·0
Scotland, West	33	23	26	27·3	12·0	40	34	33	35·7	4·0
England, N W	35	25	27	29·0	11·0	38	34	33	35·0	5·0
England, S W	38	31	28	32·3	10·3	39	39	35	37·1	6·3
Ireland, North	35	24	26	28·3	12·0	42	37	31	36·7	4·3
Ireland, South	38	27	27	30·7	10·7	43	37	35	38·3	3·3
London	37·4	24·2	24·8	28·8	10·3	34·2	32·4	29·1	31·9	7·1

The weather during the above periods was cold in both years, and the deficiency of solar heat is more noticeable, if the figures of the second and third weeks in each year are compared On several days bright sunshine occurred for several hours, yet at some stations the sunshine was so weak as to fail to mark the recording cards of Prof Stokes's sunshine recorders.

The weather over the whole of north-western Europe has been generally intensely cold, and on January 28 the temperature at Haparanda (extreme north of Gulf of Bothnia) was reported as being 60° F. below freezing point H. W C

THE AURORA OF JANUARY 31

WE have received the following communications on the recent brilliant display of aurora :—

HAVING noticed an auroral light through the mist on the evening of January 30, I looked out last evening, the 31st, and saw what to me at least was a new appearance. There was a strong yellowish-white auroral light in the north, with an uneven boundary—not a well-defined arch From it there arose, at intervals of a minute or two, what looked like wisps of luminous mist of an elliptical form, with their longer axes east and west. These chased one another towards the zenith, appearing and disappearing with great rapidity, so that one could hardly say "look!" before they had vanished Sometimes three or four were flashing out at once They were of large size, and being unaccustomed to the description of such objects, I know not how to describe their size. They must however have subtended horizontally angles of 45° and more at the eye. This appearance lasted, from the time I first looked out at about 6h 45m., for about ten minutes or less, and then the appearance gave place to ordinary streamers, yellowish-white at their base and rosy towards their summits.

The flashing lights which I have mentioned suggested to me this idea One has seen two men shaking a carpet held at two adjoining corners Their strokes not exactly coinciding, an irregular, undulatory movement is produced, something like the waves of a chopping sea. If a stratum of *something* was in such a state of undulation above the atmosphere, and became visibly luminous where the crests of the undulations dipped down into the atmosphere, it would produce the kind of appearance that I saw OSMOND FISHER

Harlton Rectory, Cambridge, February 1

LEST the magnificent auroral display of last evening has not been generally visible, the following short account of it, as witnessed here, may not be unacceptable to the readers of NATURE

At about 6.15 p m indications of the disturbance were noticed in an unusually bright appearance of the sky from the north-east to north west by west, the light being white, and similar in character to that reflected from the upper part of a bank of fog By 6.25 the upper limit of this phenomenon had gradually changed into a number of bands, alternately bright and dark, but not well defined, which after another short interval disappeared in a change of the light to a very ruddy tint, accompanied by a kind of throbbing in the north, exactly like rapid repetitions of faint lightning At this period a great number of parallel bands of light of a beautifully clear salmon tint were extended from the ruddy bank in a southerly direction, those from the north passing beyond the zenith, and losing their definition in a diffused patch of light of the same colour These bands slowly faded away, but were succeeded by a similar and equally beautiful display at from ten to fifteen minutes later

About seven o'clock I walked two and a half to three miles in a northerly direction, and found in ascending a slight hill that the fog was sufficiently thick to obscure the stars This I imagine explains the peculiar bank and thick appearance of the light near the horizon.

The whitish illumination in the same quarter of the sky was still visible at 12 p m JOHN HARMER

Wick near Arundel, February 1

A BRILLIANT aurora borealis has been visible here this evening. It commenced at twenty minutes to seven, extending from west-north-west to a little east of north The western part was of a deep ruddy colour, extending (at a rough estimate) some 35 or 40 degrees from the horizon, and varied by long white streamers, one of which—nearly due north—reached to within 15 or 20 degrees of the zenith I was unable to watch it for more than a few minutes, but at half-past ten the sky in the same direction was still remarkably bright R. W. TAYLOR

Kelly College, Tavistock, January 31

A VERY brilliant auroral display was visible here last night There was a short heavy shower of hail and rain at six o'clock, and the sky was entirely overclouded. Thirty minutes later the sky was again clear, and the northern horizon was beautifully illuminated, and broad quivering bands of light stretched from thence upward beyond the zenith, some in unbroken continuity, while others were broken up. Not connected with these rays, and on the south side of the zenith, were frequent flashes of light, usually crescentic in form. The light near the horizon was silvery and moonlight like, but higher up it became much ruddier. I watched the aurora from 6.30 till 7, when I was obliged to go in-doors till 10 30, and then able to observe it again. At that time the light near the northern horizon had greatly increased in brightness, but fewer bands extended

upwards and to a less distance. As I walked home along elevated country roads, the effect produced by a dark sky on one side with a bright sky on the other, as if lighted up by an invisible full moon, was very beautiful. E H

Sheffield, February 1

THE aurora borealis which occurred last night was first visible here at 6 p m As is usual, the glow extended in an arc about 15° above the horizon, and was of a faint greenish colour.

From it arose frequent streamers of the same colour, having a slow westerly motion · these streamers attained to various heights, one at 6.55 reaching almost to the zenith; their colour, of various intensities, was as a rule greenish, but at times the streamers were of a reddish tint, more remarkably that one which occurred at 5.55, above referred to At 6 50 the low arc changed its character, becoming irregular, finally assumed the form of a double arc, of which the centres of curvature were north-east and north-west of the place of observation.

At irregular intervals, during the whole of the first half hour, after the first appearance of the aurora, a flickering arc of light would ascend from the lower arc, up to an elevation, in many cases, of about 80° At 7 p m. the aurora decreased in intensity, and at about nine o'clock had disappeared.

Cirencester, February 1 G W PREVOST

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The term's work has been delayed a little by the severity of the weather. Many of the colleges were but half filled on the regular day of meeting.

At the University Museum the following courses will be given during the term :—Prof. Henry Smith lectures on Pure Geometry, and Prof. Barth Price on Geometrical and Physical Optics. Prof. Clifton will lecture on Terrestrial Magnetism at the Clarendon Laboratory. In this department Messrs Stocker and V. Jones will lecture on Mechanics, and will give practical instruction in Physics. In the Chemical Department Dr Odling will continue his course on Organic Chemistry. Mr. Fisher will lecture on Elementary Inorganic, and Dr. Watts on Elementary Organic, Chemistry. The laboratories will be open under the direction of Messrs. Fisher, Watts, and M Robb Dr F D. Brown will lecture (for the Professor) on Chemical Affinity In the Physiological Department, in the absence of Dr. Rolleston through illness, there will be practical instruction given by Messrs. Robertson, Hatchett Jackson, and Thomas Mr. Jackson will lecture on Circulation and Respiration; Mr. Thomas on Comparative Embryology; Mr. Robertson will form a class for Practical Microscopy, and Mr Lewis Morgan will form a class for Human Anatomy

The following afternoon lectures will be given in the Museum Prof. Prestwich will lecture on the Palæozoic Strata, and Prof. Westwood will give an informal lecture on the Arthropoda In the University Observatory Prof Pritchard gives two courses, one on the Lunar and Planetary Theories, the other on General Elementary Astronomy, once a week in the evening

At the Botanical Garden Prof. Lawson gives a course of elementary botany.

At the Colleges which possess laboratories the following courses will be given :—At Christchurch Mr. Baynes will lecture on Thermodynamics; Mr. Dixon, owing to the illness of Mr. Vernon Harcourt, will continue his course on Inorganic Chemistry. At Balliol Mr. Dixon will lecture on Elementary Electricity and Magnetism; at Exeter Mr. Lewis Morgan will lecture on Histology; at Magdalen Mr. Yale will give a series of practical demonstrations on the Physiology of Circulation and Respiration.

In the School of Natural Science Prof. W. A. Tilden has been nominated as Examiner in Chemistry; Dr S. J. Sharkey, of Jesus College, has been nominated Examiner in Biology, and Mr. J. W. Russel, of Merton College, has been nominated Examiner in Physics.

An examination for a Fellowship in biological subjects will be held in March at University College. The examination will comprise papers of questions, and practical work in zoology, physiology, and botany, and will begin on Thursday, March 3, at 9 a.m. Intending candidates are desired to send in their names to the Master (if possible) before February 11, with a list of the subjects they offer for examination. They are also invited to mention any original work on which they have been engaged, and to send copies of any original articles or books on biological subjects of which they are the authors. Candidates are desired to call on the Dean with the usual testimonials and certificates on Wednesday, March 2, between 5 and 6 p.m.

CAMBRIDGE.—The senior wrangler in this year's Mathematical Tripos is Mr. Andrew Russell Forsyth, of Trinity College, born in Glasgow in 1858, and educated at Liverpool College The next two are Mr Robert Samuel Heath and Mr. Ernest Steinthal, both also of Trinity.

In connection with the list published in these columns in December, of those who had obtained first class honours in the Natural Sciences Tripos, the following statistics may be of interest :—In the year in which the Tripos was instituted (1851), 6 names appeared in the list, the same number in 1861; in 1871, 14; in 1878, 22; and in 1880, 31 passed the examination, obtaining honours. In 1869, 7 men passed the Special Examination in Natural Science for the ordinary B.A. degree, the number increased to 25 in the Easter examination of 1870, in 1878 it slightly diminished to 22, and in 1880, 16 passed the examination in December. So far as these results go, it would appear that an increasing number of those students who declare for natural science at Cambridge aim at thoroughness in their work, and are not content with that superficial smattering of book knowledge which is considered sufficient in the examination for the Pass degree

M. FERRY, the French Minister of Public Instruction, has given an important character to the next meeting of the schoolmasters of France. Each of the 40,000 teachers of the 40,000 parishes (communes) is to meet with his fellow-teachers at the proper district towns There are about 2000 of each of these little assemblies, each of which is to elect a delegate who will go to the chief town of the Department, and all these cantonal delegates are to appoint a department of delegates, who will go to Paris with a memoir written for communication and discussion before the pedagogical congress All these memoirs are to deal with questions proposed by the Government

SOCIETIES AND ACADEMIES

LONDON

Royal Society, January 27.—"*Polacanthus Foxii*, a large undescribed Dinosaur from the Wealden Formation in the Isle of Wight" By J W. Hulke, F R.S (Abstract)

A description of the remains of a large dinosaur, discovered in 1865 by the Rev. W Fox, in a bed of shaly clay between Barnes and Cowleaze Chines, in the Isle of Wight Head, neck, shoulder girdle, and fore ribs were missing, but the rest of the skeleton was almost entire Some of the præsacral vertebræ recovered show a double costal articulation. In the trunk and loins the centrum is cylindroid, relatively long and slender, with plano-concave, or gently biconcave ends Several lumbar centra are anchylosed together, and the hindmost to the sacrum The sacrum comprises five relatively stout and short anchylosed centra of a depressed cordiform cross-sectional figure The post-sacral vertebræ have a stout short centrum

The limb bones are short, their shafts slender, and their articular ends very expanded The femur has a third trochanter, and the distal end of the tibia has the characteristic dinosaurian figure

The back and flanks were stoutly mailed with simple, keeled, and spined scutes, and the tail was also sheathed in armour

The animal indicated by these remains was of low stature, great strength, and probably slow habits. It is manifestly a dinosaur, and is considered to be very nearly related to Hylæosaurus.

Linnean Society, January 20.—The Rev J. M. Crombie, F.L.S., in the chair.—The proposed alterations in the bye-laws were again successively read, voted for, and confirmed, excepting sect. 2, chap. viii, which was not confirmed.—Portfolios of British sea-weeds and zoophytes, prepared by Mr. W Smith of Falmouth, were exhibited by the Rev. J. Gould.—A squirrel's nest was also shown and commented on by Mr. Chas. Berjeau —A new form of microscopical cabinet designed by Mr W Hillhouse of Cambridge was explained by him, its compactness and portability rendering it advantageous to teachers —Mr. Thos. Christy exhibited some horn-shaped galls growing on a branch of *Pistacia atlantica*, and somewhat similar in appearance to those known in India under the name of "Kalera-singhi" galls. From the galls a substance exuded not unlike Chian turpentine; Mr Christy also drew attention to the fruit of the

White Quibracho —Notes on the Orchideæ formed the subject of an important contribution from Mr. G. Bentham Orchids early attracted the attention of botanists, though their popularity as objects of cultivation is comparatively a recent phase due in a great measure to Loddige's celebrated collections and to the fashion set up by the Duke of Devonshire in his famous Chatsworth collection, a still further incentive being given by Chas. Darwin in his studies of their singular modifications of fertilising apparatus and its protecting perianth. In their classification Swartz's labours (1800), thereafter the Richards', Dupetit Thouars, and others, have been superseded by the influx of strange forms then unknown Rb Brown first established the principles of their natural arrangement on a solid basis, and Lindley's grouping remains true till the present day. Blume's observations must always take a high rank, and good analytic generic characters and illustrations obtain in the works of Sir W. Hooker, Wight, Griffith, Fitzgerald, and others The younger Reichenbach has devoted great attention to the group, but we still lack from him a synopsis of contrasted characters adaptive to limitation of tribes and genera Dr Pfester has of late studied their vegetative characters advantageously, while J. G. Beer proposes divisions founded on modifications of the labellum, unfortunately neglecting other structural peculiarities In reviewing the Lindleyan system Mr. Bentham observes that the primary division based on the consistence of the pollen has not been replaced by any other equally good, although it is by no means absolute He admits that the distinctions dependent upon the so-called *caudicles* and gland can scarcely be maintained, independent of the confusion occasioned by the term having been applied to three different parts of the pollinary system. The result of Mr. Bentham's extended examination of all growing and dried specimens procurable, and of the literature extant, is that he divides the order into five tribes and some twenty-seven sub tribes, as indicated below, and he further gives lengthened explanations of these and of the more remarkable genera, &c — ORCHIDEÆ, *Tribe I Epidendreæ*—Subtribes (1) Pleurothalleæ, (2) Microstyleæ, (3) Lipariéæ, (4) Dendrobieæ, (5) Erieæ, (6) Bletieæ, (7) Coelogyneæ, (8) Stenoglossæ, (9) Laelieæ, *Tribe II Vandeæ*—Sub tribes (1) Eulophieæ, (2) Cymbidieæ, (3) Cyrtopodieæ, (4) Stanhopieæ, (5) Maxillarieæ, (6) Oncidieæ, (7) Sarcantheæ, (8) Notyleæ, *Tribe III Neottieæ*—Sub-tribes (1) Vanilleæ, (2) Corymbieæ, (3) Spirantheæ, (4) Diurideæ, (5) Arethuseæ, (6) Limodoreæ, *Tribe IV Ophrydeæ*—Sub-tribes (1) Serapiadeæ, (2) Habenarieæ, (3) Diseæ, (4) Coryceæ, *Tribe V Cypripedieæ*. —In a paper by Mr Edw J. Lowe on some hybrid British ferns, the author's experiments lead him to believe that *Polystichum aculeatum* and *P. angulare* are forms of one species, and *P lonchitis*, *Lastrea recurva*, and *L. Alpina* are merely mountain forms of *P angulare* and *L. dilatata* respectively Spores of *Athyrium Filix fœmina* were mixed, viz, vars *Victoriæ*, with *frizelliæ* and *proteum* and var *Fieldiæ*, with *Pulleri* and var *Howardiæ*, with *Du Boulæ*, whence sprung varieties of singular beauty and vigour.—A revision of the genus *Viburnum* was a communication by Mr W Phillips, which was taken as read

Geological Society, January 19 —Robert Etheridge, F R S, president, in the chair.—Jabez Church, M Inst.C E, George Augustus Freeman, B.Sc Lond, Charles Horsley, C E., Edwin Simpson-Baikie, F.L S, and Charles John Wood, M Inst.C E., were elected Fellows of the Society William Henry Goss was proposed as a Fellow of the Society —The following communications were read:—Further notes on the family Diastoporidæ, Busk, by G. R. Vine, communicated by Prof. P. Martin Duncan, M.B Lond, F.R.S In continuing his review of the family of the Diastoporidæ, the author stated that upon the question of the classification of the Polyzoa he is inclined to accept the views recently published by the Rev T Hincks in preference to the earlier ones enunciated by Prof. Busk. He now described the forms found in the Lias and Oolite, including *Diastopora stromatoporides*, Vine (= *liassica*, Quenst.), *D. ventricosa*, Vine, *D oolitica*, Vine, *D. cricopora*, Vine. The author then proceeded to argue against the inclusion of the foliaceous forms in the genus *Diastopora*, and concluded by giving a definition of the genus, as now limited by himself —Further notes on the Carboniferous Fenestellidæ, by G. W Shrubsole, F.G.S. The author pointed out the discrepancies in the descriptions given by Lonsdale, Phillips, McCoy, and King of the genus *Fenestella*, as represented in the Silurian, Devonian, Carboniferous, and Permian formations respectively. He then proposed a new definition of his own, and described the following species.—*F plebeia*, McCoy, *F. membranacea*, Phil. *F. nodulosa*, Phil., *F. polyporata*, Phil, *F crassa*, McCoy, *F halkinensis*, sp. nov.; and in conclusion he pointed out that the few species to which he has reduced the Carboniferous Fenestellæ find their representatives in the North American continent, only one really new form, *F. Norwoodiana*, having been described there.

Physical Society, January 22 —Prof. W G Adams in the chair —New Member, Mr G Palgrave Simpson, B.Sc —Notes on the construction of the photophone, by Prof Sylvanus Thompson, were read by Prof Rheinold Prof Thompson was led by experiment to question whether Prof. Bell's form of photophone receiver was adapted to give the best results Theoretically he finds with a given maximum of incident light distributed uniformly over the surface, the change of resistance in a selenium receiver will vary proportionally with its linear dimensions, provided its parts be arranged so that on whatever scale constructed the normal resistance shall remain the same. A cell n times greater linearly each way will produce n times the variation in resistance for the same total amount of light This follows from Prof W G Adams' law that the change in the resistance of selenium is directly as the square root of the illuminating power. The author also finds that if the thickness of the conducting disks in the enlarged cell be kept the same as before and their number increased n times, the change of resistance will be n^3 times as great as before Selenium cells should therefore be as large as possible, and the light should be distributed over them uniformly, not focussed to a point A conical mirror would therefore be better than a parabolic one to receive the beam Such a reflector would be cheaper to construct, and there would be a minimum loss by reflection, as the light would fall perpendicularly on a cylindrical cell parallel to its axis To give the best effect, its angular semi-aperture should be 45°, and this will bring the front end of the cell in the same plane as the mouth of the reflector Prof Thompson has also constructed an improved cell by winding parallel wires on a cylinder of slate grooved with a double-threaded screw, and filling the interval between them with selenium. This form gives superior effects to Prof. Bell's disk device Mr Shelford Bidwell said that long annealing improved the sensitiveness of selenium for photophone purposes. He got the best speech from cells of high total resistance, made with fine wire The selenium should however have a low specific resistance. With the apparatus he showed at a recent meeting of the Society he could now transmit articles from NATURE and the *Nineteenth Century* so as to be heard, every word, by the listener Prof. Guthrie suggested that amorphous phosphorus should be tried in place of selenium as a more permanent substance —Mr Glazebrook, of the Cavendish Laboratory, Cambridge, read a paper on the measurement of small resistances and the comparison of the capacities of two condensers. In measuring small resistances by the Wheatstone balance the results differed on varying the resistance in the battery wires According to Prof Chrystal this was due to a thermo-electric effect produced by the hand at the middle point of the divided platinum iridium wire when the contact is made with it It could be avoided by making this contact first and then making the battery contact Mr. Glazebrook investigated the effect mathematically and experimentally. He suggested that the resistance in the battery wire should be kept small in comparison with the other resistances, and then the effect was inappreciable It could best be eliminated by taking two measurements with reversed currents and calculating out. The author next considered the effect of a small leakage in comparing condensers by the Wheatstone balance method The sensibility of this method is increased by increasing the two resistances and the resistance of the galvanometer. Dr. Hopkinson stated that he had found a modification of this plan to be very promising For the battery he uses an induction coil, and for the galvanometer a telephone Thus a high electromotive force and sensibility was obtained

Anthropological Institute, January 11 —Edward B Tylor, F R S, president, in the chair.—Mr G. M Atkinson exhibited some stone celts from British Guiana.—Mr John Evans, F.R.S, gave a short account of the proceedings of the International Congress of Prehistoric Archæology and Anthropology held at Lisbon in September last, at which he had been present in the capacity of delegate from the Institute. One of the excursions was to Otta, to inspect the beds in which it was thought that traces of man living in Miocene times had been discovered This discovery had been accepted by many members of the Congress, but Mr. Evans had not been satisfied as to the un-

doubtedly human origin of the single bulbs of percussion on the flints, nor as to their actually forming integral parts of the beds in or on which they were found, nor as to the geological antiquity of the beds themselves.—The President read a communication from Mr. F. F. Tuckett, on the subject of a supposed diminution in the size of heads during the last half century—A paper by Mr. W. D. Gooch was read, on the Stone age in South Africa. The paper was illustrated by a large number of specimens collected by the author.

Royal Asiatic Society, January 24.—Sir H C. Rawlinson, K.C.B, president, in the chair.—The following gentlemen were elected as Resident Members:—Colonel S. C Law, E. H. Man, J. W. McCrindle, and Thomas T. Fergusson, Rev. Mr. Cain, Atmaram S. G. Jayakar of Maskat as Non-Resident.—A paper was read by Mr. Simpson, F.R.G.S., on the identification of Nagara-hara with reference to the travels of Hiouen-Tsang. Nagara-hara, he stated, was the name of the chief city of the Jelalabad Valley, as also of the Province, the extent of which, according to Hiouen-Tsang, was probably from Gundamack to the Khyber Pass. It was visited by Hiouen-Tsang and Fah-Hian, who describe some of the buildings in it, at the same time referring to its distance from Hidda (now Hada), and thus confirming the suggested identification. Mr. Simpson stated that when in the Jelalabad Valley with General Sir Samuel Browne's column in 1879, he made many explorations into the Buddhist remains there, discovering, *inter alia*, an isolated rock covered with ruins of Buddhist masonry, bearing the local name of Bala-Hissar (*i e.* "the Citadel"), the whole ground about it being strewed with stones and fragments of topes Around it may also be seen a series of ridges, most likely the remains of the ancient defences of the town. Hiouen-Tsang states that it was four miles in circumference, and that it was six miles from Hidda, both of which measures agree exactly with those made by Mr. Simpson. M. Vivien de St. Martin, who very nearly worked out a correct map of this district in his "Mémoire sur la carte de l'Asie Centrale," was, Mr. Simpson states, misled by the map published in the "Ariana Antiqua."

Statistical Society, January 18—Mr. James Heywood, F R.S, in the chair—The following papers were read—On the method of statistical analysis, by Wynnard Hooper.—On the growth of the human body, by J. Towne Danson.

PARIS

Academy of Sciences, January 24.—M. Wurtz in the chair.—M. Berthelot presented a supplement to his recent work, containing various new measurements by himself and others.—The following papers were read.—On the periodic development of any function of the radii vectores of two planets, by M. Tisserand.—On the theory of heat, by M. Resal.—On a new disease caused by the saliva of a child that had died of hydrophobia, by MM. Pasteur, Chamberland, and Roux. Rabbits inoculated with the dilute saliva died within thirty-six hours; symptoms, loss of appetite, paralysis, asphyxia, congestion of trachea, with hæmorrhage, swellings in groin, axillæ, &c. Other rabbits inoculated with saliva or blood from the first soon died also. The disease is attributed to a small organism (found in the blood), it is of rod shape, constricted at the middle and surrounded by mucous matter. It is like the microbe of chicken cholera, but has no effect on fowls. By artificial cultivation it is changed in form somewhat. Guinea-pigs, though so like rabbits, seem hardly affected by inoculation. Dogs that were inoculated died in a few days, but without symptoms of rabies The disease seems distinct from rabies, but the authors do not at this stage affirm its absolute independence.—Experiments proving that thiotetrapyridine and isodipyridine have not the poisonous power of nicotine, whence they are derived, by M. Vulpian.—The mechanical contact of gneiss and limestone in the Bernese Oberland, observed by M. Baltzer, by M. Studer. M. Baltzer was requested by the Swiss Geological Commission to study the superposition of gneiss on the Jurassic system in the region named. This he did in 1874-76, and his observations are given in the work now presented.—M. Heer was elected Correspondent in Botany in place of the late M. Schimper.—Elements and ephemerides of comet *f* 1880 (Pechule), by M. Bigourdan.—Presentation of a photograph of the nebula of Orion, by Prof. Draper. The exposure was for fifty-one minutes.—On the divisions of certain homogeneous functions of the third order with two variables, by M Pepin.—On the distinction of integrals of linear differential equations in sub-groups, by M Casorati.—On the separation of the roots of equations, the first member of which is decomposable into real factors and satisfies a linear equation of the second order, by M. Laguerre.—On the development of elliptic integrals of the first and second species in entire recurrent series, by M. Farkas.—On the choice of unit of force in absolute electric measurements, by M. Lippmann. The electric standards and chief theoretical formulæ being independent of choice of the unit of force, the choice is not of very great importance, and a change of it is always easy. The dyne presents no essential advantage in some cases For unification of measurement in electricity and the rest of physics electricians might take for fundamental units the second, metre, and gramme—Laws of liberation of electricity by pressure in tourmaline, by MM. Jacques and Curie. The two ends of a tourmaline liberate equal quantities of contrary electricity. The quantity liberated by a certain increase of pressure is of contrary sign and equal to that produced by equal diminution of pressure It is proportional to variation of pressure, and independent of the length of the tourmaline. For a given variation of pressure per unit of surface it is proportional to the surface.—On baryta used to obtain arsenic, with arsenious acid and sulphides of arsenic, by M. Brame—Action of dry carbonic acid on quick lime, by M. Raoult. When CO_2 is sent into (say) 100 gr quick lime in a glass vessel which has been heated to the point at which the glass begins to soften, the lime absorbs the gas very powerfully, and becomes incandescent, remaining so about fifteen minutes A bibasic carbonate is produced It is practically impossible to produce neutral carbonate of lime by direct synthesis. Lime that has once been heated over 1100° acts on dry carbonic acid at a much slower rate than before.—On the losses of nitrous compounds in manufacture of sulphuric acid, and a means of attenuating them, by MM. Lasne and Benker The means referred to are a direct injection of sulphurous acid.—On the resistance to flexure of tempered glass, by M. de la Bastie. This is proved from experiments to be considerably superior to that of ordinary glass.—On cholestène (cholestérilène), by M. Walitzky—On the preparation of crotonic aldehyde, by Mr. Newbury.—On the *Mus pilorides*, or musk-rat of the Antilles, considered as a type of a new sub-genus in the genus *Hesperomys*, by M. Trouessart.—Formation of the blastoderm in Araneides, by M. Sabatier.—Resection of two metres of the small intestine, followed by cure, by M. Koeberlé.—The wild vines of California, by M. de Savignon. There are five varieties of these, though all have hitherto been usually comprised under the name *Vitis Californica*—On *Theligonum cynocrambe*, L., by M Guilland.

CONTENTS

THURSDAY, FEBRUARY 10, 1881

ALPINE FLOWERS

Alpenblumen ihre Befruchtung durch Insekten und ihre Anpassungen an dieselben Von Dr Herman Muller, Oberlehrer an der Realschule I. Ordnung zu Lippstadt 8vo, 611 pp (Leipzig W. Engelmann, 1881.)

THE naturalist who studies animals or plants in a state of nature must often wish that he could test his conclusions experimentally by varying the conditions under which a given set of facts are observed He wishes that he could change the food of a group of organisms, or the climate to which they were exposed, or that he could diminish the numbers of one sub-group while those of another were increased. As he cannot do this he is obliged to be content with treating the facts within his grasp in the spirit of an experimentalist, by comparing large classes of facts as they occur under different conditions

The present volume of Dr Muller's is something more than a descriptive study of the means of fertilisation found among alpine plants, for it is an admirable example of the kind of comparative investigation to which we have alluded, and as such is an extremely valuable contribution to the general science of plant-fertilisation

It is a difficulty inherent in such inquiries that the observer, not having had a hand in varying the conditions, has to discover exactly in what way the environments differ in his two stations of observation The most important feature in the environment of a plant considered in relation to fertilisation is the manner in which it is visited by insects Thus an extensive knowledge of the alpine and lowland insect fauna is a necessary part of Dr Hermann Muller's inquiry Nor is it enough to study as an entomologist the relative frequency of bees, flies, butterflies, &c, in the mountains and in the plains, but the observer must discover by long and patient observation the different manner in which these insects visit the flowers in the two regions. The amount of this kind of labour condensed into the volume may be guessed at by looking at the long lists of insect-visits appended to each plant described, or arranged in the statistical tables in the latter part of the book

The collection of this mass of detail must have tried Dr Muller's almost unbounded energy and patience to the utmost Several weeks in each of the last six summers have been devoted to the research, and the record of a single day's work (which we are glad to find was a somewhat exceptional one) will show how well the time at his command has been utilised. On this day, which was spent in the Heuthal on the Bernina, he was surrounded by flowers and insects from 8 a m. to 4 p.m, during which interval he made notes on the visits of 237 insects, 225 of which were numbered and brought home. Dr Muller adds that he was continuously spurred to the utmost of his powers by the consciousness that numbers of insects were making unobserved visits behind his back

Nor has his energy and ingenuity in classifying and tabulating his results been less remarkable, as will be seen by an examination of the twelve tables which are interspersed in the latter part of the book; in these tables the visits of the various orders of insects to various kinds of flowers in different localities are numerically compared

It is not a little remarkable that the visits of insects, which to the ordinary observer appear so casual and lawless, should be capable of such strict and statistical treatment But it should be remembered that treatment of this kind is only possible with the large mass of facts which Dr Muller has collected

The most striking facts in the book are those connected with the predominance of butterflies in the alpine regions The changes which occur in the insect fauna as we ascend are briefly that the relative number of Lepidoptera and Diptera (especially the short-trunked flies) increase, while the Hymenoptera and Coleoptera, as well as the other unimportant kinds, diminish in relative number Thus if we compare the number of different visits made to flowers in the lowlands and the alps,[1] we find the following proportions —

	Lowlands	Alps
Lepidoptera	100	614
Diptera	100	109
Hymenoptera	100	35·5

the number of visits made by each order of insects in the lowlands being taken as 100

One marked result is that classes of flowers chiefly visited by bees in the lower regions are in the alps much frequented by Lepidoptera Thus, of a hundred different visits made to Papilionaceæ in the lowlands 73 per cent are those of Apidæ, 17 per cent are made by Lepidoptera, so that in the plains they are markedly "bee-flowers" But in the alps only 40 per cent of the visits made to Papilionaceæ are those of bees, and 56 per cent are those of Lepidoptera The same fact was observed in the Labiates and in a number of Composite flowers The adaptations which alpine flowers exhibit in relation to this preponderance of Lepidoptera form some of the most interesting parts of the book; with some of the facts the readers of NATURE are already familiar, through Dr Muller's admirable articles on the subject which have appeared in these pages The principle which underlies these alpine modifications may be illustrated by two sections of the genus Gentian. In the first of these (Cœlanthe) fertilisation is effected by humble-bees creeping inside the corolla This necessitates so wide a tube that Lepidoptera can steal the nectar without effecting fertilisation The second section, Cyclostigma, is characteristic of the alpine regions, and the flower has been adapted for fertilisation by Lepidoptera The passage by which the nectar is reached is so narrow that the proboscis of the butterfly is obliged to touch the anthers, and to effect cross-fertilisation At the same time the tube in many of the Cyclostigmata is so much lengthened that only such a long proboscis as that of Macroglossus or of Deilephila can reach the nectar It is probable that the first steps towards the development of closed nectaries were originally serviceable to the plant in protecting the nectar from rain, the flowers being thus rendered more attractive, because the visiting insects had a chance of finding undiluted nectar even after a shower. The lengthening of the corolla tube in the above-mentioned section of Gentians which protects the nectar from all but a few long-trunked insects, confers the same kind of advantage on the flower, for it is thus rendered highly attractive to those insects which can alone obtain

[1] Alpine as used by Dr Muller means above the tree-limits

the honey; and they will fly from flower to flower, passing over the less attractive kinds

The genus Rhinanthus has been made especially interesting by Dr Muller. Rhinanthus is essentially a "bee-flower," but *R. alpinus* has been modified so as to be fertilised by Lepidoptera. The ordinary entrance by which bees visit the flowers of *Rhinanthus cristagalli* is here closed, and a special "butterfly-door," a minute aperture at the tip of the upper lip, has been developed; it is moreover advertised to Lepidoptera by a pair of violet flaps on each side of the entrance. The interesting point about this genus is the existence in it of a species which shows in what manner the flower of *R. alpinus* (fitted for Lepidoptera) may have been developed out of a "bee-flower" such as *R. cristagalli*. This intermediate form (*R. alectorolophus*) possesses a "Lepidoptera-door" like that of *R. alpinus*, but has not closed the bee-door; it is therefore visited by both bees and Lepidoptera and cross-fertilised by both. In spite of our knowledge of this interesting intermediate form, the evolution of *R. alpinus* remains a difficulty. For although it is adapted for the legitimate visits of Lepidoptera only, it is plundered by bees, who break in by the closed bee-door; and these useless or injurious visits are actually more frequent than the advantageous ones of Lepidoptera. It seems impossible to believe that a butterfly-flower could be developed under such circumstances, and the only explanation which Dr Muller offers requires the assumption of two changes of condition. First, the spread of the bee-fertilised ancestors into regions (such as the Heuthal in the Bernina) where they would be visited exclusively by Lepidoptera, and where the present form of the corolla might be developed. Secondly, we must suppose that the plant has spread into regions where it is visited by bees, or else the plant has remained stationary while bees have invaded its habitat. A similar kind of argument is applied to those flowers, *Polygala alpestris*, various Papilionaceæ, &c, which, though structurally adapted for fertilisation by bees, are, in the alps, chiefly visited by Lepidoptera. They cannot therefore have been developed in their present habitat, but must have spread to the alps from the lowland regions.[1] Dr Muller compares flowers like *Rhinanthus alpinus*, Gentiana, (Cyclostigma), *Erica carnea*, &c, to air-breathing vertebrates which have been derived from water-breathing ancestors, whose gills have been replaced by special air-breathing structures—the lungs; while *Rhinanthus alectorolophus* corresponds to those intermediate forms which still possess both gills and lungs. We may perhaps, by an inversion of the simile, compare such plants as *Polygala alpestris*, a nearly unmodified bee-flower visited almost exclusively by Lepidoptera, to the Cetacea, which, though actually breathing air, lead almost the life of a fish.

Dr. Muller's treatment of the genera Rhinanthus and Gentiana are instances of the manner in which many other groups are treated. Thus the interesting series of forms exhibited by the Caryophylleæ suggest the possible steps through which bright-coloured flowers adapted for Lepidoptera, such as those of the pinks, have been developed from the pale-coloured scentless flowers with unprotected nectar which are chiefly visited by Diptera.

[1] This view is, for reasons given in the text, put forward merely as a speculation (p. 559)

The present volume gives continual evidence of Dr Muller's knowledge of the structure and habits of insects. But it does not (and this could not have been expected) contain anything like the valuable study of insects contained in the author's "Befruchtung"—a research of which we take this opportunity of expressing our high admiration, in which we shall be joined by those of our readers who remember the excellent articles by Dr. Muller on insects which appeared in these pages.

In considering the modifications of flowers produced by their relations to insects, we are prepared to find that, for instance, flowers fertilised by bees differ in shape from those visited exclusively by Lepidoptera, but it does not seem *primâ facie* probable that the colours should be characteristic of the two classes. Yet Dr Muller believes that this is the case, and shows how it may probably be connected with fundamental differences between the lives of bees and butterflies. A bee having to work not only for its own livelihood but also for its nest, is driven to a greater degree of activity than the self-indulgent butterfly. It is therefore important that a bee should work with more method, and thus it happens that bees usually visit one species of flower at a time, instead of passing from species to species and wasting time in the constant change of action. On this account it is obviously an advantage for a bee to be able to distinguish easily a large number of species, thus their unconscious selection has acted in the direction of producing great variety of colouring. It is indeed a remarkable fact that flowers which are visited by short-trunked insects are often characterised by a single colour (usually yellow or white) running through a whole group, whereas closely-related "bee-flowers" are generally varied in colour.

Here then we have a curious chain of cause and effect, beginning with the fact that bees have to provide food for their young, and ending with the varied colours of species of Labiates, Pedicularis, and Trifolium, &c! If any proof is needed of the correctness of the first link in the argument, it may be found in the curious fact that parasitic or cuckoo bees differ markedly from other bees in their habits,[1] visiting merely those flowers whence they can obtain enough honey for themselves with least trouble and doing it in a dawdling manner which meets with no approval from Dr Muller.

In the flowers adapted for or chiefly visited by Lepidoptera, red and in a less degree blue are the prevailing tints. There seem to be some grounds for believing that butterflies prefer flowers resembling themselves in tint. Thus in sunshiny weather the orange-yellow flower-heads of Arnica, *Senecio Doronicum*, &c, and the orange-red ones of *Crepis aurea* and *Hieracium aurantiacum* are veritable "Tummelplatze" for yellow-red species of Argynnis and Melitæa. On the other hand the blue Phyteumas which decorate the alpine turf in thousands are especially visited by blue Lepidoptera ("Blues"). It is hard to say whether the butterflies have preferred flowers coloured like themselves, because these tints have been already rendered attractive through sexual selection. Or whether *vice versâ* we may suppose that the colours of their favourite flowers have reappeared as sexual decoration, or lastly, that

[1] P. 522. Dr Müller adds a caution that the number of observations on this point are perhaps hardly sufficient to warrant a well-grounded conclusion

some physical quality in their organisation makes certain colours attractive wherever they appear

To Dr. Hermann Muller belongs the credit of studying not only the means by which cross-fertilisation is effected, but also the means for ensuring cross-fertilisation He has indeed made this subject peculiarly his own, and has worked it out with valuable and striking results He has pointed out that flowers which are incapable of self-fertilisation may run great risks of not being fertilised at all Whereas the flowers in which self-fertilisation is possible are in no danger of becoming sterile, though they may lose the advantage of cross-fertilisation He has shown that in many plants two forms of flowers exist, one adapted for cross- the other for self-fertilisation This is the case with *Lysimachia vulgaris* ("Befruchtung," p. 348); when it grows in sunny places where it is freely visited by insects, it has large dark-yellow petals coloured red at the base, conspicuously coloured filaments, and sexual organs arranged so that self-fertilisation can hardly occur, the other form grows in shady ditches, and has a pale yellow corolla and inconspicuous filaments, and the style is so short that self-fertilisation will be sure to take place if no insects visit the flower

The present volume, though it does not, as far as we are aware, add anything new in principle to the subject of self-fertilisation, contains many illustrations of the correctness of Dr. Muller's views

We cannot pretend to give, in the short compass of a review article, any fair idea of the richness of Dr Muller's latest work in new facts and generalisations, we conclude by expressing a hope that it may before long find a translator, or what is a much greater difficulty—a publisher in England.

FRANCIS DARWIN

OUR BOOK SHELF

Lehrbuch der organischen Qualitativen Analyse Von Dr. Chr Th Barfoed Zweite Lieferung (Kopenhagen Andr Fried Höst und Sohn, 1881)

THE first part of this excellent book has already been noticed in these columns The book is to consist of three parts, the second, which is now published, is characterised by the same completeness and exactness which rendered the earlier part so valuable as a reference book for the laboratory The present part treats fully of the methods for detecting, in mixtures of varying degrees of complexity, alcohol, ether, chloral, neutral fats, volatile oils, sugar, gum, albumin, &c

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.

The Editor urgently requests correspondents to keep their letters as short as possible The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Mr Butler's "Unconscious Memory"

MR. BUTLER appears to have somewhat misunderstood the aim and scope of my review He says, "It is true I have attacked Mr Darwin, but Mr. Romanes has done nothing to show that I was not warranted in doing so" Why should Mr Butler have expected any such consideration of his case from me? If I were to assault a man in the street I should not expect the policeman to show that I was not warranted in doing so, it would be for me to show that I was so warranted. Therefore, while acting the part of policeman in this matter, my only object was that which I stated, viz the punishment of an offender, not the refutation of charges which I advisedly characterised as "preposterous, and indeed ridiculous" Truly it would have been a senseless thing had I for a moment imagined that such charges called for anything like a defence of Mr Darwin. If ever in the world's history there was a book which appealed to all classes of intelligent readers, that book is the "Origin of Species", and never in the world's history has a book been more studiously criticised or produced a more tremendous change of thought Can Mr Butler therefore seriously believe, that after this book has thundered through the world for more than twenty years, it required him to show in what degree it had been anticipated by some of the most celebrated writers within the last two or three generations? Surely common modesty and common sense, were either present, might alike have dictated caution in attributing to all the world an ignorance such as his own, which could be "thrown off the scent of the earlier evolutionists" by anything that Mr Darwin could say. The publication of the "Origin of Species" could only have had the effect, whether or not its author desired it, of directing renewed attention to the works of "the earlier evolutionists", and therefore, to put it on no other grounds, it is difficult to imagine a case in which any intentional concealment of the claims of predecessors could well be more impolitic But the simple fact is that these predecessors had no claims to be concealed, further than those mentioned in my previous communication, that is to say, while they unquestionably and *notoriously* believed in the fact of evolution, they had nothing which deserves to be called a theory of evolution Therefore, when Mr Butler asks of the opening passage in the "Origin of Species," "What could . . . more distinctly imply that the whole theory of evolution that follows was a growth in Mr Darwin's own mind?" the answer simply is that this whole theory *was* a growth in Mr Darwin's own mind And if Mr Butler has not judgment enough to distinguish between the scientific value of Mr Darwin's work and that of "the earlier evolutionists," at least he might pay sufficient deference to the judgment "of all Europe and those most capable of judging" to explain why it is that the work of all the earlier evolutionists proved barren, while the work of Mr Darwin has produced results unparalleled in the history of thought

But I am being drawn into a mere waste of time in thus discussing what every one must feel does not admit of discussion My object in now writing is not to justify Mr. Butler's view that Mr. Darwin requires to be defended from any such nonsensical "attack", I write in order to withdraw two passages from my review Mr. Butler says I was wrong in implying that he supposed Mr. Darwin to have entered into a conspiracy with Dr. Krause, he merely supposes Dr Krause to have acted the part of a "cat's-paw" In this therefore I stand corrected, for while reading "Unconscious Memory" it never occurred to me that Mr Butler's view was other than I stated The second passage which I desire to cancel is that which attributes a motive to Mr. Butler in publishing "Evolution, Old and New" He scornfully repudiates the motive which I attributed, and I therefore willingly withdraw the attribution- observing merely that I was induced to advance it because it seemed to present the only rational motive that could have led to the publication of such a book.

Two other allusions to myself may be noticed before I end Mr Butler says, "I suppose Mr. Romanes will maintain me to be so unimportant a person that Mr Darwin has no call to bear in mind the first principles of fair play where I am concerned." To this I answer emphatically, No, but I do maintain that had Mr Butler been a more important person than he is, he would not have regarded the mere omission of a foot-note of reference to his book, either as an intentional wrong to himself, or as a matter of such grave concern to the public

Lastly, Mr. Butler says, "I maintain that Mr Darwin's recent action and that of those who, like Mr. Romanes, defend it, has a lowering effect upon this standard [*i e* of good faith and gentlemanly conduct]" I am sure the world of science ought to feel very grateful to Mr Butler for his kind solicitude on the subject of its morals and gentlemanly feeling But he has already said in "Unconscious Memory" that he does not look to "ladies and gentlemen of science" for much sympathy, seeing that his case rests on "facts," and that among these "ladies and gentlemen" "familiarity breeds contempt of facts", and I fear that in this his conclusion will prove better than his argument For unless some facts and feelings are displayed other than those already exhibited, I cannot think

that either the morality or the courtesy of the scientific world is likely to be improved by the renewed exertions on their behalf which are about to be made by Mr. Samuel Butler.

GEORGE J. ROMANES

[This correspondence is now closed.—ED.]

WILL it go any way towards calming Mr. Butler's zeal in the cause of literary honesty to remark that at any rate fifteen years ago, and it may have been further back, Mr. Darwin prefixed to "The Origin of Species" a historical sketch of the progress of opinion on that subject? In view of this it is at least very *misleading* on the part of Mr. Butler to quote the first sentence from the edition of 1859, and then to ask: "What could more completely throw us off the scent of the earliest evolutionists?" as if in those days it would have made a pin's difference to him, or any one else whom he includes in the *us*, whether the scent of the earlier evolutionists lay strong or weak in the track. In these days he should know, if he knows anything of the history of opinion, that these predecessors of Mr. Darwin, with their great though varied merits, had been laughed down, and, for all popular estimation, might be said to have disappeared. To have relied in any way on their authority when Mr. Darwin's book was first published might well have increased the mountain of prejudice against his views without in any way relieving the weight of ridicule that lay upon theirs. When the whole scientific world had been stirred to its foundations and when the whole world almost had been roused into paying attention to science by the awakening genius displayed in the new exposition *de rerum naturâ*, then, when it could best be done, Mr. Darwin turned ridicule into renown, and made all who could even remotely claim to have anticipated or shared his views participators of his fame. Not those who scatter seed at random, but those who cultivate it in chosen ground with indefatigable industry and prevailing skill should, I imagine, be considered the chief benefactors of mankind; and in like manner the fancy that may have fluttered uselessly through many brains becomes at last a fruitful hypothesis or a wide-stretching theory when it falls beneath the cultivation of undaunted genius.

T. R. R. STEBBING

Tunbridge Wells, February 7

"Prehistoric Europe"

WILL you kindly allow me a few words in reply to certain statements made by Prof. Dawkins in his notice of my "Prehistoric Europe"? I shall not remark on the perplexing confusion which he gravely puts forward as an outline of my general argument further than to say, in all sincerity, that I fail to recognise in it any trace of what that argument really is. The few observations I have to make shall be confined chiefly to questions of fact.

1. Mr. Dawkins states that I ask geologists to believe that the mammaliferous gravels with Palæolithic implements, which overlie the chalky boulder-clay of East Anglia, were covered by an upper and younger boulder-clay, which latter "has been removed so completely that no trace of it is now to be seen." Now I do not believe that the gravels in question ever were covered by boulder-clay, nor have I written anything which could justify Mr. Dawkins in attributing to me an opinion so absurd.

2. The account I have given of Victoria Cave was written after a careful perusal of all that has been said about it, and my proofs were submitted to Mr. Tiddeman, who reported on the explorations, and therefore I have every reason to believe that my description is correct.

3. The so-called Upper Pliocene deposits at Mont Perrier are described in detail by Dr. Julien, who shows that they are truly interglacial, being younger than the great "pumiceous conglomerate" with its striated stones and blocks, and older than the more recent moraines of the same neighbourhood. Dr. Julien remarks: "La période pliocène supérieure doit disparaître de la science." He correlates the interglacial beds of Mont Perrier with those of Dürnten.

4. The lignites of Leffe and Borlezza, according to Prof. Stoppani, who has carefully studied those closely adjoining districts, belongs without any doubt whatever to the glacial series; and his observations I have confirmed by a personal examination of the ground. They are generally admitted by Italian and Swiss geologists to be on the same horizon as the lignites of Dürnten.

5. I have not asserted the interglacial age of the so-called Pliocene of Olmo. The newer deposits in the Upper Val d'Arno, which have usually been assigned by palæontologists to the Upper Pliocene, have been shown by Prof. Mayer, after an exhaustive analysis of the evidence (as well stratigraphical as palæontological) to belong to the Pleistocene, and as their mammalian fauna corresponds with the fauna of the lignites of Leffe and Borlezza, I have said that this fact is "significant," meaning thereby that the beds in question may very likely be of the same age as those near Gandino.

6. Mr. Dawkins says that I deal with my subject not with the impartiality of a judge, but as an advocate, and that I have only called those witnesses which count on my side. I am probably as well acquainted with the literature of the subject as my critic, and after many years' careful reading and study must confess that I have not encountered any evidence that contradicts my views. Had it been my fortune to come upon such evidence I feel sure that I should not have been so weak and foolish, or so untruthful as to have ignored it. Doubtless I have met with many forcible statements of opinion by Mr. Dawkins that he does not agree with me; but I may remind him (and not for the first time) that mere expressions of opinion, however emphatic, prove nothing save, as a rule, the sincerity of him who utters them.

7. My critic further ventures the statement that my classification "is based on ice, and ice only." How very far this is from being the case any candid person may see who shall take the trouble merely to run his eye over the "contents" of my book. Geologists rightly refuse to accept classifications which are based upon so narrow a foundation as a single series of phenomena, such, for example, as Mr. Dawkins's attempt to classify the Pleistocene by reference to the mammalia alone—a classification which, while it draws the line that separates Pliocene from Pleistocene at the base of the glacial deposits in England, would carry the same line, in France and Central Europe, through the middle of the glacial series. Or, to put it another way, if we accepted Mr. Dawkins's classification, we should be forced to admit that the Glacial Period attained its climax in France and Central Europe during Pliocene times, but that it did not begin in England until after the Pleistocene had commenced. And this is the classification which, as may be inferred from the tenor of my critic's remarks, I ought to have adopted.

Mr. Dawkins's remarks upon my views in regard to the evidence of climatic changes I am sorry to say I do not understand. All that I am sure of is that he has quite failed to grasp my meaning—that he has attributed to me opinions which I have done my best to refute—in a word, that he has strangely misrepresented me. But I need not attempt to set him right, as those who are sufficiently interested in the matter are not likely, after this repudiation, to accept his travesty for a reliable presentment of my views.

JAMES GEIKIE

Perth, January 7

On Dust, Fogs, and Clouds

A CURIOUS confirmation of Mr. Aitken's theory of fog was brought to my notice a short time ago. A friend of mine residing in Streatham, struck with the perfection of the heating arrangements in American residences, fitted up his house with a similar contrivance. In the basement was a furnace and boiler which warmed pure air that entered from without, and circulated at a regulated temperature throughout the house. A water-pipe that was connected with the boiler became stopped by frost, an explosion ensued, and the house was filled with so-called steam (hot fog, in fact) from top to bottom. Wherever a cold surface (clock faces, metal fixtures, &c.) was found, even in the topmost bed-rooms, the vapour condensed and left behind it black carbon dust. Nowhere else was this dust found.

Again, few persons who have read Mr. Aitken's paper can have noticed the dejected appearance of the late beautiful snow on the first morning of the welcome thaw without thinking of his theory. What on the previous evening was a clean dazzling mass of exquisite white became a sooty speckled heap of dirty snow. As the sparkling crystals liquefied into water which drained away, they left behind the dust and carbon, around which, according to Mr. Aitken, they originally formed, becoming by multiplication molar and visible. In the streets of London the masses of white snow rapidly became, as somebody remarked, like streams of cold *café au lait*. The whiteness rapidly disappeared and left behind mere dirt.

It may interest some of your readers to know that in 1537

Benvenuto Cellini was attracted to Paris from Florence in consequence of the much clearer and more beautiful atmosphere in the capital of France than in Italy! This fact is derived from the artist's autobiography. What a change now! Paris is rapidly becoming as bad as London. W. H. PREECE

February 5

IN NATURE, vol. xxiii. p. 195, I found an interesting abstract of a paper read to the Royal Society of Edinburgh, December 20, by Mr. John Aitken, showing "that dust is the germ of which fogs and clouds are the developed phenomena." It is not in the least the intention of this letter to diminish the value of the above-mentioned paper and experiments, but I wished to say that already, several years past, the same results were obtained by Messrs. Coulier and Mascart (1875) in France (*Naturforscher*, 1875, p. 400; *Journal de Pharmacie et de Chimie*, série 4, xxii. p. 165).

In my "Théorie cosmique de l'Aurore Polaire," p. 36, I have already pointed out the great importance of these results on the relation between auroræ and clouds and the danger of measuring the height of auroral displays by means of superior cloudy apparitions (p. 35). In fact, if the invisible aqueous vapour is able to reach much higher regions than terrestrial dust, and if auroræ are in close connection with cosmical matter in a state of extreme division, like our theory attempts to prove, this cosmical matter is without any doubt enabled to form aqueous clouds in a much higher than the usual level. Moreover we have already, in 1873, in the German journal *Gaea* (Köln und Leipzig, E. H. Mayer), asked: "Welches wohl die weitere Rolle der Eisen- und anderen Dämpfe sei, welche nach der Verbrennung in den oberen Regionen der Atmosphäre schwebend bleiben und offenbar nach vollständiger Abkühlung einen Niederschlag von fein vertheiltem Eisenoxyd und anderen Stoffen bilden. Sollten diese Theilchen . . . keine Veranlassung geben können zu den von deutschen Beobachtern so oft wahrgenommenen 'Polarbandern,'[1] deren Zusammenhang mit dem Nordlicht schon öfters dargethan ward, aber bisher unerklärt blieb. Noch würden wir hinzufügen können, mit Hinweis auf die Beobachtung Secchi's eines angeblichen Nordlichts bei Tage (NATURE, October 17, 1872), dass auch die bis jetzt ganz unerklärte, eigenthümliche Gestalt der Cirri, mit ihren ganz regelmässigen, auf ein gewisses Gesetz hindeutenden transversalen Verzweigungen, von der Anwesenheit feiner Eisenstaubkerne in den Eisnadeln möglicherweise bedingt ist. Bekanntlich schweben diese Cirri in den höchsten Wolkenregionen."

It will further be generally known that microscopic meteorites have been found in the centre of hailstones (*Comptes rendus*, 1872, p. 683). H. J. H. GRONEMAN

Groningen (Netherlands), January, 1881

[1] On "Polarbanden." My daily observations of these phenomena, beginning with the year 1875, are to be found in the German journal *Wochenschrift*, editor, Dr. Hermann J. Klein in Köln.

New Cases of Dimorphism of Flowers—Errors Corrected

REVIEWING my notes and drawings of some years ago, I find the following new cases of dimorphism of flowers:—

1. *Syringa persica*, L., cultivated in the garden of the Lippstadter Realschule, is gynomonœcious. In the same inflorescence there are found a majority of hermaphrodite flowers of larger size and a minority of female flowers of smaller size. The hermaphrodite flowers are homogamous and short-styled, like *Syringa vulgaris*, L. (H. Müller, "Die Befruchtung der Blumen," p. 340, Fig. 125). The anthers of the female flowers, which are much reduced in size and never contain any pollen, are inserted sometimes above, sometimes beneath, but commonly in the same height with the stigma. In some few of the small-sized flowers the number of the petals is reduced to three.

2. *Stellaria glauca*, L., near Lippstadt, is gynodiœcious, like *St. graminea*, L., as described by F. Ludwig (*Bot. Centralblatt*, No. vi. p. 28), some stems bearing small-sized flowers with very reduced anthers of white colour and greatly-developed stigmas, a vast majority of other stems bearing larger-sized proterandrous flowers with anthers of red colour.

3. *Sherardia arvensis*, L., near Lippstadt, is likewise gynodiœcious, its hermaphrodite flowers being proterandrous and larger-sized, with a corolla of 3½-4 mm. diameter, its female flowers possessing a corolla of only 2½-3 mm. diameter, with extremely reduced anthers.

4. *Asperula tinctoria*, L., produces in Thuringia so frequently flowers with only three petals that in those stems examined by myself by far the greatest part of the flowers were three-petaled.

In my book "Alpenblumen" Dr. Focke of Bremen has detected two errors of naming, which immediately ought to be corrected: the flower described and illustrated on p. 171 is not *Empetrum nigrum*, but *Azalea procumbens*, like that of p. 377. *Cerinthe*, in pp. 264, 265, is not *major*, L., but *glabra*, Mill. = *alpina*, Kit. HERMANN MÜLLER

Lippstadt

Geological Climates

I HAVE read with much interest and attention the letters that have appeared in recent numbers of NATURE on the subject of "geological climates," and although it must appear presumptuous on my part to do so, I shall endeavour to show that each of the distinguished writers of these letters may be somewhat in error on at least one point, which—if I am right—must materially affect the correctness of the conclusions they have come to.

I think that Mr. Wallace, whilst very justly giving the Gulf Stream and other currents which *might* exist were certain lands submerged, credit for great influence in ameliorating the rigour of climate, does not take into sufficient consideration the fact that the waters of the Gulf Stream, although warmer, are, in consequence of holding much more salt in solution, heavier than the colder and less saline Arctic current.

Some experiments show, as clearly as anything done on a very small scale can, that two waters brought as nearly as possible to the conditions of the Gulf Stream and the Arctic current do not mingle when simultaneously poured into a long narrow glass trough, the Arctic water invariably taking its place on the surface.

Supposing then that these two currents meet somewhere about latitude 80° or 81° N., the Arctic water flowing south—if my experiments are of any value—will retain its position on the surface and the warm current pass underneath, and thus lose all its heating influence on the air over a Polar area about 1000 geographical miles or more in diameter.

We can have no stronger example of this effect of difference of density of ocean water than is shown by the two currents *in* and *out* of the Mediterranean Sea.

In NATURE, vol. xxiii. p. 242, Prof. Haughton says, "The thickness of this ideal ice cap at the Pole is unknown, but from what we know of the Palæocrystic ice of Banks Land and Grinnel Land *must be measured by hundreds of feet, and its mean temperature must be at least* 20° F. *below the freezing-point of water*."

With regard to both the above assumptions—which are in italics—I must beg to disagree entirely with the learned Professor. He appears to consider the so-called Palæocrystic ice as the normal state of the ice at and near the Pole, and as a natural growth by the gradual freezings or increase of a single floe during a series of years, whereas I am of opinion that this mis-called Palæocrystic ice is the result of a number of floes being forced over and under each other by immense pressure caused by gales of wind and currents.

The western and northern shores of Banks and Grinnel Lands are peculiarly well suited for the formation of such ice heaps, as they are exposed to the full force of the prevailing north and north-west storms, which pile up the ice in a wonderful manner on these shores and others similarly placed, for a distance of miles seaward. The whole of the west shore of Melville Peninsula is so lined with rough ice of this kind that sledging is impossible.

It will wholly depend upon the form of land—if any—at or near the Pole, whether or not any floebergs are there. If there is no land it is probable there will be few or none, as the ice will meet with no great obstruction, as it is driven by winds and currents.

I have no authorities by me that give the thickness of ice formed in one season at or near the winter quarters of any of the Arctic expeditions, except my own in 1853-4 at Repulse Bay, latitude 66° 32′ north.

The measurements of the ice—taken at some distance out in the bay where there was very little snow—and the mean temperature of the air are given on next page.

1853	Ice thickness	Increase	Monthly Mean Temp F
December 20	... 4 feet 7 inches	—	.. −24° 5 below zero
1854			
January 24	. 5 feet 9 inches	14 in 35 days	−30° 6 " "
February 2	.. 7 feet 0½ inch .	16 in 32 days .	−34° 9 " "
April 25[1]	8 feet 1½ inch	12½ in 59 days ...	− 8° 5 " "
May 25	. 8 feet 1½ inch .	none 30 days	+24° above zero

The above table shows that the ice ceased to increase in thickness some time between April 25 and May 25, after which it decreased rapidly, but I was unable to decide what proportion of this decrease was due to thaw and evaporation from the surface, and what amount from the lower part of the floe that was under water no doubt by far the greater effect was produced by the two first causes.

Eight feet may perhaps be considered a fair or rather a high average of one winter's formation of new ice (not increase of an old floe) over the whole of the Arctic Sea, because Repulse Bay, although in a comparatively low latitude, was particularly favourable for ice-formation, there being no currents of any consequence. Where there are currents, one year's ice does not exceed three or four feet.

The winter's ice of 1875–6 at Discovery Bay, in latitude 81° 40′ N, did not exceed, if I remember correctly, six feet in thickness

Even were these great compound floes, called Palæocrystic ice, found at or near the Pole, and of only the same thickness as those seen at Grinnel Land—instead of "hundreds of feet"—they would not probably have nearly so low an average temperature all the year round as 20° F. below the freezing-point of water, because only one-sixth of their mass would be exposed to very low temperatures for about six months of the year, the surface being during that time protected by a more or less thick covering of snow, whilst at least five sixths of their bulk was under water, having a temperature for the whole twelve months at or above the freezing-point of the sea The question is, how far the very low temperatures of an Arctic winter do penetrate a mass of, say sixty feet of ice, the surface of which is covered with a foot of snow, and fifty feet or five-sixths under water of a temperature at or above the freezing-point of the sea?

From my experience on a much smaller scale, I do not believe that the atmospheric cold would, under the circumstances mentioned, penetrate to the lower surface of ice sixty feet thick, and if it does not do so there would be no increase to its thickness during winter[2]

An excellent example of formation of Palæocrystic ice, or floe-berg is afforded by the experience of the Austro Hungarian Expedition under Weyprecht and Payer in the Barentz Sea in 1873-4. Their ship was lifted high out of the water by the pressure of the floes, which were forced over and under each other to a great thickness and extent in a very few days

The ship and her crew were helplessly drifted about for many months, during which the floes were frozen together into one solid mass, and the inequalities of the surface in a great measure filled up with snow-drift. JOHN RAE

4, Addison Gardens, January 29

[1] The mean temperature opposite to April is that of March and April combined, and it will be seen that the average increase of ice for each of these months is only 6¼ inches

[2] That the sea raises the temperature of the ice on its surface even in very cold weather, is evinced by the fact that a snow hut built on the ice is warmer than if built on the land.

On the Spectrum of Carbon

IN addressing to you my former letter regarding Dr. Watts's experiments on the spectrum of carbon, it was not my intention to enter on any discussion concerning matters of opinion The reference made in that letter to the difficulty of perfectly drying a gas so as to eliminate the ultra-violet spectrum of water had reference to gases at ordinary atmospheric pressure, and the expectation a gas will be dried "to all intents and purposes" by the use of a U tube of phosphoric anhydride goes far to explain the origin of different experimental results The cogent experimental evidence which Dr. Watts justly demands may, so far as the relations of carbon and nitrogen are concerned, be found in our complete papers on the spectrum of carbon compounds in the *Proceedings* of the Royal Society.

The supposition, which appears to be a difficulty to Dr. Watts's mind, that traces of nitrogen in hydrocarbons give with the spark the spectrum of nitrocarbons, and that traces of hydrogen in cyanogen give the hydrocarbon spectrum, is not only "reasonable," but appears to me most consistent with the spectrum observations on the whole, and with the chemical regarding the formation and relations of acetylene and hydrocyanic acid.

Cambridge, January 22 G D. LIVEING

Vibration of Telegraph Wires During Frost

MR T. M READE asks for an explanation of this phenomenon. In *Science Gossip* for 1874, p. 254, there is a short article of mine on "Frost Phenomena," and one of those referred to is this curious vibration of telegraph wires

The explanation there suggested, which was only a guess, is probably incorrect; but I think I can give the true one now, and it is, as usual in such cases, extremely simple

Hoar frost is only deposited in air which is nearly at rest, a strong wind shakes it down as it forms But there is nearly always a slight air-current in one definite direction, and the ice spicules are built up "in the teeth" of this current, that is on the windward side of the wire or twig.

They always point *towards* the wind. When they have attained a length of, say, half an inch, if the direction of the air-current slightly changes, it may strike the comb-like fringe no longer on the points, but on the side, and, obtaining thus a leverage upon the wire, will twist it round till the pressure is balanced by the torsion. If the pressure were absolutely constant the wire would perhaps remain in this position, but the very slightest variation of pressure would set up a vibratory motion, and this, I think, must be the true cause of the phenomenon

Birstal Hill, Leicester, February 5 F T. MOTT

The Star Oeltzen, 17681

THE star Oeltzen, 17681, whose spectrum was announced by me to consist mainly of a yellow and blue band (NATURE, vol xxii p. 483), proves to belong to the same class as the three stars in Cygnus discovered by Wolf and Rayet in 1867 (*Comptes rendus*, vol lxv p 292). A curious feature of these spectra is that they resemble each other without being identical, the relative brightness of the lines being very different. A further study of them is much to be desired.

Cambridge, U.S, January 24 EDWARD C PICKERING

Zeuglodontia

IN consequence of my letter in NATURE, vol xxiii p 54, the sub-editor of the *Graphic* was kind enough to send me the number of that paper containing the engraving of the animal seen from the *City of Baltimore* (not *City of Washington*, as I had misunderstood), and which is that of April 19, 1879 The sketch from which this was taken was sent by Major H. W J Senior of the Bengal Staff Corps, with the following description, viz. —

"On January 28, 1879, at about 10 a.m., I was on the poop deck of the steamship *City of Baltimore*, in lat 12° 28′ N long 43° 52′ E. I observed a long *black* object abeam of the ship's stern on the starboard side, at a distance of about three-quarters of a mile, darting rapidly out of the water and splashing in again with a sound distinctly audible, and advancing nearer and nearer at a rapid pace. In a minute it had advanced to within half a mile, and was distinctly recognisable as the veritable 'sea-serpent' I shouted out 'Sea serpent! sea-serpent! call the captain!' Dr C. Hall, the ship's surgeon, who was reading on deck, jumped up in time to see the monster, as did also Miss Greenfield, one of the passengers on board By this time it was only about 500 yards off, and a little in the rear, owing to the vessel then steaming at the rate of about ten knots an hour in a westerly direction On approaching the wake of the ship the serpent turned its course a little away, and was soon lost to view in the blaze of sunlight reflected on the waves of the sea. So rapid were its movements that when it approached the ship's wake I seized a telescope, but could not catch a view, as it darted rapidly out of the field of the glass before I could see it. I was thus prevented from ascertaining whether it had scales or not, but the best view of the monster obtainable when it was about three cables' length, that is about 500 yards distant, *seemed to show that it was without scales*. I cannot, however, speak with certainty. The head and neck, about two feet in diameter, rose out of the water to the height of about twenty or thirty feet, and the monster opened its jaws wide as it rose, and closed them again as it lowered its head and darted forward for a dive,

reappearing almost immediately some hundred yards ahead The body was not visible at all, and must have been some depth under water, as the disturbance on the surface was too slight to attract notice, *although occasionally a splash was seen at some distance behind the head.* The shape of the head was not unlike pictures of the dragon I have often seen, *with a bulldog appearance of the forehead and eyebrow* When the monster had drawn its head sufficiently out of the water it let itself drop, as it were, like a huge log of wood, prior to darting forward under the water. This motion caused a splash of about fifteen feet in height on either side of the neck, much in the shape of a pair of wings."

The italics in the foregoing and in the account of Capt Cox are my own.

FIG 1 —The Animal as seen from the *City of Washington*

The engraving being a large one, of which the foreground is formed by the deck of the steamer, I have copied and send with this that portion of it which shows the animal; and in this it should be observed that besides the splash rising round the neck "like wings," the separate splash at some distance behind the head is also shown, the position of which corresponds to that where the cetacean tail occurs in the figure sent by the captain of the *Kiushiu-maru*, which accompanied my first letter The foam around the neck, I think, may be due to the splash of the humeroid paddles which a cetacean should possess.

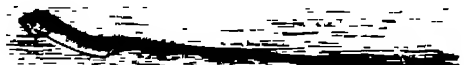


FIG 2 —The Animal as first seen from H M S *Dædalus*

The sub editor of the *Graphic* has also been kind enough to obtain for me tracings from the three figures given in the *Illustrated News* of October 28, 1848, of the animal seen from the *Dædalus*. From two of these I have made the accompanying reductions to one fourth (linear) of the originals; and the head portrayed in one of these (as seen when the animal passed close under the stern of the *Dædalus*) is evidently not reptilian, but mammalian, and it seems to bear out the "bulldog appearance of the forehead and eyebrow" which Major Senior describes in his case.

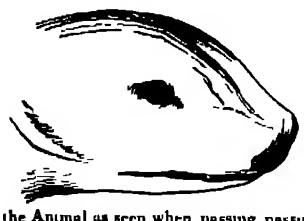


FIG. 3 —Head of the Animal as seen when passing passing under the stern of the *Dædalus*

From the *Times* of September 24, 1879, I cut the following notice —

"Capt. J. F Cox, master of the British ship *Privateer*, which arrived at Delaware breakwater on the 9th inst. from London, says '—'On the 5th ult, 100 miles west of Brest (France), weather fine and clear, at 5 p.m., as I was walking the quarter-deck, looking to windward, I saw something *black* rise out of the water about twenty feet, in shape like an immense snake about three feet in diameter. It was about 300 yards from the ship, coming towards us. It turned its head partly from us, *and went down with a great splash*, after staying up about five seconds, but rose again three times at intervals of ten seconds, until it had turned completely from us and was going from us with great speed, *and making the water boil all round it* I could see its eyes and shape perfectly It was like a great eel or snake, *but as black as coal tar*, and appeared to be making great exertions to get away from the ship I have seen many kinds of fish in five different oceans, but was never favoured with a sight of the great sea-snake before.'"

In this account we have almost a duplicate of that of Major Senior in the dropping of the animal with a great splash into the water prior to its darting forward under it, while the boiling of the water around, which is so inconsistent with the motion of a snake in water (which I have more than once seen) evidently resulted from the strokes of the cetacean tail, and possibly also from those of the paddles, as in the case witnessed by Major Senior The black colour also is described in both cases

Capt. Drevar, the statutary declaration of whom and of several of his crew I quoted in my former letter, has written to me, and sent me a printed account (which he says he has circulated) of the conflict which he witnessed, and of the subsequent appearance of the animal rearing its long neck out of the water This is satisfactory as showing that the declaration I quoted was no hoax, as I feared it might have been, but Capt. Drevar rejects with disdain my suggestion that the animal he saw was not a serpent, though I pointed out to him that nothing having the form of a snake would possess in its submerged portion the buoyancy necessary to enable it to elevate so great a proportion of its length out of water.

Judging from the figures which accompany this and my previous letter, it appears to me that the external form of the animal must resemble the well-known *Plesiosaurus*, if we imagine the hinder (femuroid) paddles of that *Enaliosaurian* to be absent, and a cetacean tail (which is their homologue), to be present in their stead. Since in the direction of the *Porpesse* the cetacean in external form so closely simulates the fish, so it may in another direction simulate this Mesozoic marine saurian, or the gigantic *Elasmosaurus* of the American Cretaceous formations, of which a nearly perfect skeleton is described by Prof Cope as forty-five feet in length, the neck constituting twenty-two of this length

Whether, through your circulation, any light on this subject, so far as the character of the skeleton of *Zeuglodon cetoides* is concerned, may be forthcoming from American palæontologists remains to be seen, but there ought, I submit, to remain no longer with naturalists any doubt that a hitherto unknown group of carnivorous cetaceans, with necks of extraordinary length, inhabit the ocean.

It seems to me also most probable that the conflicts which have been so often witnessed (and which Mr Pascoe in his letter in NATURE, vol xxiii p 35, says he himself twice witnessed), and referred to the Thresher, have been attacks by the animals in question upon whales. SEARLES V WOOD

Martlesham near Woodbridge

Ice Intrusive in Peat

I HAVE just returned from a walk on the shore at Crosby, where I have been much interested in observing one of the effects of the late severe frost combined with the present thaw

At the Alt Mouth is a submarine peat-and forest-bed, and, lying over it, I was much surprised to see innumerable slabs of peat, which an examination showed in most cases contained interlaminations of ice. One slab measured 5 yards by 2¾ yards by about 8 inches thick, and right through its mass in a parallel plane with the surface, separating the peat into an upper and lower layer, was a slab of transparent ice, wedge-shaped, being 4 inches thick at one side, diminishing to 1 inch at the other. How the ice got there was the surprising thing, as the peat is very hard and compact, and about 18 inches thick. The holes or places from which the sea had quarried these frozen slabs were plainly to be seen, and I noticed round one of them that the edges or lips of the peat had been forced up by ice inserting itself between the laminæ.

A good deal of water ordinarily oozing through the sandhills flows or trickles over the surface of the peat, and as nearly six inches of rain fell in December last, and the two previous months were wet, the quantity of water would be abnormally increased. In some way or other it must have percolated along the peaty laminæ, and by gradual accretion the frozen water has forced up the layer of peat above it. This has occurred at neaps, and the late high tides, assisted by the thaw and the decreased specific gravity of the mass, has lifted the frozen slabs of peat and

inclosed slabs of ice, and torn them from the unfrozen and softer peat below. The slabs may be compared to sandwiches, the ice representing the meat. The ice is evidently fresh-water ice, and possesses a striated prismatic structure at right angles to its surface. In places it protrudes like a tongue from the peat, and is then occasionally perforated with round holes evidently melted through it.

Is it not possible that some of the beds mentioned by geologists in Russia and North America, consisting of alternate layers of ice and earth or gravel, may have been formed similarly by percolation of water, and not be truly bedded, but intrusive?

T. MELLARD READE

Park Corner, Blundellsands, January 30

P.S.—Since writing the above I have again visited the shore to-day, but all the slabs have been rafted out to sea by the high tide. With my geological hammer I broke off some of the frozen peat *in situ*, and find the explanation given to be substantially correct, but I also found that the upper layer of peat was minutely and beautifully interlaminated with ice. It is quite evident that the ice is the frozen water which has percolated from the sand-hills.

January 31

The Squirrel Crossing Water

NEVER having heard of the squirrel taking to the water, I send the following authentic communication. I had heard the story told by another person, and thinking it of sufficient interest I requested her to get it in detail from the lady under whose personal observation it had come. This the latter has most kindly complied with, and I forward it, trusting it may prove of interest to some of the readers of NATURE interested in the habits of animals. Loch Voil, in Perthshire, near Balquhidder, is about four miles in length, with a mean breadth of about one third of a mile—a considerable extent of water for so small a rodent to face and cross, in search, I suppose, of new nutting grounds.

H. H. GODWIN-AUSTEN

Thalford House, near Guildford, February 5

"*Mountquhanie, Cupar Fife*

"When rowing two ladies down Loch Voil, one afternoon last August, I observed what looked like a little stripe of red-brown fur in the middle of the loch. On coming nearer we saw that it was a squirrel swimming across, its tail lying flat on the water. We then heard its claws scratching on the side of the boat, and to our surprise the little bedraggled sprite appeared on the bow of the boat. It was evidently tired, for it sat quite still, staring at us and panting. I rowed on towards the shore, hoping to be able to ferry it across, but after a few minutes it scrambled down to the water again and resumed its journey, probably frightened at the sight of the collie dog who was in the boat. We watched it swimming till it looked like a small speck close to the shore, but lost sight of it before it landed."

SEA-WAVES.—E. B. P., 18, Cromwell Place, S.W., asks: Can any reader of NATURE inform me as to in what books or pamphlets I can obtain the best information relating to the height and length of sea waves, especially when considered in relation to the navigation of vessels?

BARON NORDENSKJOLD IN FINLAND[1]

AS is known, Baron Nordenskjold was born in Finland, and completed his studies at the University of Helsingfors. After his recent visit to St. Petersburg, where the celebrated explorer was made much of, he promised to stop at Helsingfors a few days, for the first time after his successful discovery of the North-East Passage and his circumnavigation of the Eurasian Continent. Having previously paid a short visit to his paternal hall (Frugard), Nordenskjold, accompanied by the Baroness his wife, arrived at Helsingfors on the evening of January 13. He was received at the railway station by a deputation consisting of the Rector of the University, Mr. H. Lagus, the President of the Finnish Society of Science, Mr. G. Mittag-Leffler; the Secretary, Mr. L. L. Lindelöf, and others, as well as a select chorus of students, who sang a few patriotic songs. Before the station-house a crowd numbering thousands of people stood cheering and greeting him.

On January 14 the Society of Science had arranged a special meeting, to which friends and followers of science had been invited, and at which were present members of Government, professors of the University, a few of the higher military dignitaries, and a great many fashionables of the town, ladies as well as gentlemen. After an interesting lecture "On the Religions of the Populations of Siberia" by the linguist, Prof. A. Ahlquist, the President of the Society of Science, Mr. Mittag-Leffler, presented to Baron Nordenskjold a gold medal struck by order of the Society of Science, in memory of their renowned countryman and honorary member, and of the remarkable historical event. The presentation of the medal was accompanied by an address, in which it was stated that the Society of Science, being neither wealthy nor numerous, and well remembering to what a little nation it belonged, could not and would not try to compete with the many eminent scientific societies which had already honoured him with their grants and gifts. Yet the Society of Science hoped Baron Nordenskjold would kindly accept this tribute of admiration, as having issued from his native country. Nordenskjold expressed his gratitude in a hearty manner, and then gave a lecture on his "Observations of the Northern Lights at Behring Strait," which greatly excited the interest of his audience. Nordenskjold was then entertained at dinner by the Scientific Society and the University, at which entertainment toasts were given in honour of Baron Nordenskjold, the Baroness, and the members of the *Vega* Expedition. At the close of the dinner a torchlight procession, arranged by students, appeared, paying homage to their celebrated countryman by singing and cheering.

The Helsingfors Skating Club having meanwhile adorned its skating-rink on the ice with electric lights and innumerable lamps and torches, then had a visit from the Baron. He was received with singing by a student chorus, followed by the appearance of two polar bears with a chair on skates, who, giving him kind regards from Spitzbergen and Siberia, took him at a tremendous rate up to a pretty little ice temple, where he was greeted by twelve young ladies and gentlemen, all dressed in the picturesque costumes of the Chukchis. These gave him a hearty welcome, and then, with the bears, performed a characteristic dance on skates. Surrounded by thousands of cheering spectators, he was taken back to his carriage again by the bears. In expressing his gratitude Nordenskjold said that if the Chukchis, and especially the ladies, had been so civilised he would most certainly not have left them so soon.

The following day he was invited to dinner by the Governor-General of Finland, Count Adlerberg, and in the evening the inhabitants of Helsingfors gave a splendid banquet, at which toasts were given in honour of the Emperor Alexander II. and King Oscar II., followed by a speech by Prof. L. L. Lindelof, relating Baron Nordenskjold's great deed, and inviting the audience to drink to his health. Other toasts were also given in honour of the Baroness Nordenskjold, the promoters and members of the *Vega* Expedition, the Fatherland, &c. Nordenskjold's appearance in Finland excited great rejoicing everywhere, but amid that rejoicing the melancholy thought occurred to one's mind that he had been denied the opportunity of living, and acting, and working in his own country.

On January 16, early in the morning, he left Helsingfors; once more the singing of the students sounded on the platform amid loud cries of "Hurrah" from friends and admirers.

[1] From a Helsingfors Correspondent.

THE JOHN DUNCAN FUND

MR JOLLY informs us that the subscriptions sent to form a fund to raise this old botanist above the need of parochial relief and provide for his comfort during his remaining years, has already reached a considerable sum, all which has been sent spontaneously from all parts of the country, without the formation of any committee or pressure whatever. More is coming in daily, and the old man's future independence would seem in the end to be pretty well assured The sympathy shown in the case has been widespread and of the warmest kind Her Majesty the Queen has graciously sent 10*l*, and the Duke of Argyll, who sent 10*l*. at first, writes that it is a subscription which ought to be zealously supported by all who are interested in the pursuit of science, and who honour the high moral and intellectual qualities by which John Duncan is distinguished All this speaks well for the generosity of the country, but more is required The case is without doubt unusually deserving

The following is a list of the subscriptions which have been received at this office during the past week --

	£	s	d		£	s	d
Amount previously announced	11	15	0	Clay, Sons, & Taylor	1	1	0
Matthew Gray	2	0	0	Dr Sim	1	0	0
F A. Hamilton	2	0	0	Henry Stretch	0	2	0
Received in Registered Letter	2	0	0	A A Rathbone	3	0	0
Jas. Greig	0	10	0	A G.	0	10	0
George Russell	0	10	0	Sidney Billing	0	10	0
Thomas Clarke	1	1	0	A. W Agnew	1	0	0
A Friend	0	10	0	Orry's Dale	0	5	0
L M	3	3	0	John Renton Dunlop	1	0	0
F V.	0	2	6	Prof Prestwich, F R S	2	2	0
Miss Wilson	0	5	0	George Knott	1	1	0
Isaholt Fraser	0	3	0	H F R	0	10	0
Mrs Tuckwell	0	10	0	Mrs Henry	1	0	0
Alfred Shipley	1	1	0	Miss Wen	0	10	0
E. H Millar	1	0	0	An Old Woman	0	2	6
John Noble	5	0	0	A E	0	10	0
W .	0	10	0	J E. B	2	2	0
					48	6	0

EXPERIMENTS ON ICE UNDER LOW PRESSURES

CERTAIN theoretical considerations on the relations of the solid, liquid, and gaseous states of matter led me three or four years ago to the speculation that in a perfect vacuum the liquid state would be impossible, and that under this condition it might be possible to raise bodies to temperatures above their ordinary melting-points These ideas were mentioned to one or two friends at the time, but they naturally considered them as speculations which would not be verified by experiment From the pressure of other work the subject was for the time dropped, and it was not till the autumn of 1879 that an experimental investigation was commenced The first substance tried was sulphur, but this was ultimately found to be unsuitable, as under low pressures, though it apparently boiled as low as 130° C., yet at that or a little above that temperature it began to froth Naphthalene was then tried, but as the pressure at which the boiling-point fell below the melting-point was less than about 7 mm, it was not easy to *maintain* the pressure at a sufficiently low point Mercuric chloride however, which was the next body tried, yielded better results

Mercuric chloride melts at 288°, resolidifies at 270°-275°, and boils at 303°. About 40 grammes of the pure compound were placed in the tube A (Fig 1), and a thermometer arranged with its bulb imbedded in the salt The drawn-out end of the tube was connected by stout india-rubber tubing with one branch of the three-wayed tube B, whilst the other was attached to the manometer C B was connected with a Sprengel pump fitted with an arrangement for regulating the pressure When the pressure had been reduced by means of the pump to below 420 mm, the mercuric chloride was strongly heated by the flame of a Bunsen's burner, with the following results — Not the slightest fusion occurred, but the salt rapidly sublimed into the cooler parts of the tube, whilst the unvolatilised portion of the salt shrank away from the side of the tube, and clung tenaciously in the form of a solid mass to the bulb of the thermometer, which rose considerably above 300° C, the mercury shooting up to the top of the stem After slight cooling, the air was let in, and under the increased pressure thus produced the salt attached to the bulb of the thermometer at once melted and began to boil, cracking the tube at the same time

The experiment was next varied as follows —About the same quantity of chloride was placed in the tube as before and heated by the full flame of a Bunsen's burner The lamp was applied during the whole of this experiment, and the size of the flame kept constant throughout The

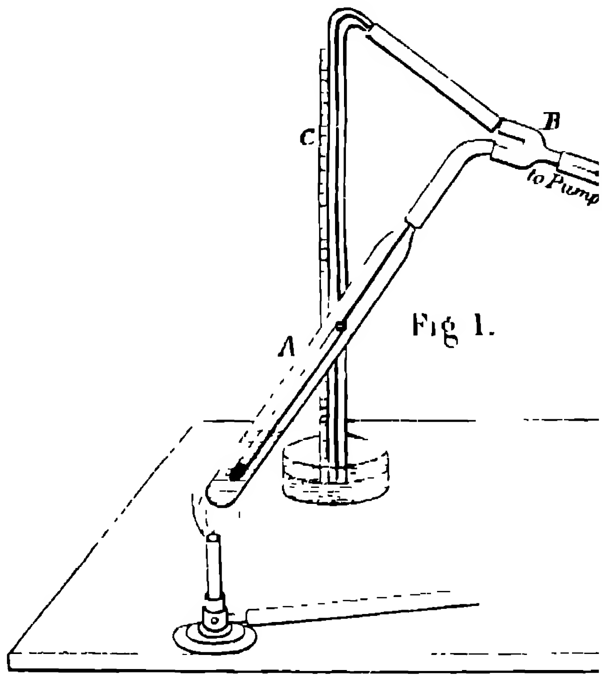


Fig 1.

mercuric chloride first liquefied and then boiled at 303° under ordinary pressure, and whilst the salt was still boiling the pressure was gradually reduced to 420 mm, when the boiling-point slowly fell to 275°, at which point the mercuric chloride suddenly began to solidify, and at 270° was completely solid, the pressure then being 376 mm When solidification was complete the pump was stopped working, but the heat still continued to the same extent as before The salt then rose rapidly to temperatures above that at which a thermometer could be used, but not the least sign of fusion was observed From the completion of the solidification to the end of the experiment the pressure remained at about 350 mm

The above experiment, which was repeated three times, shows therefore that when the pressure is gradually reduced from the ordinary pressure of the atmosphere to 420 mm, and the boiling-point simultaneously from 303° to 275°, the salt solidifies while it is still boiling, notwithstanding that it is being strongly heated at the same time, and that, after solidification is complete at 270°, the temperature then rises far above the ordinary boiling-point (303°) of the substance without producing any signs of fusion. Under ordinary circumstances mercuric chloride melts at

288° and re-solidifies at 270°-275°, *i.e.* at a temperature identical with that at which it solidifies under diminished pressure as above described

After the above experiments had been made the investigation had to be unavoidably deferred, and was not resumed till last autumn, when a large number of determinations were made of the boiling-points of several different substances under various pressures, and from these was drawn the general conclusion described in a letter to NATURE (vol. xxii. p. 434), in September last, viz.. "In order that any solid substance may become liquid it is necessary that the pressure be *above* a certain point, called the critical pressure, otherwise it cannot be melted, no matter how great the heat applied." Assuming the truth of this conclusion, I set to work to apply it in the case of ice, as it would undoubtedly have the greatest interest in connection with that substance On this account my experiments since the end of August have related almost solely to ice

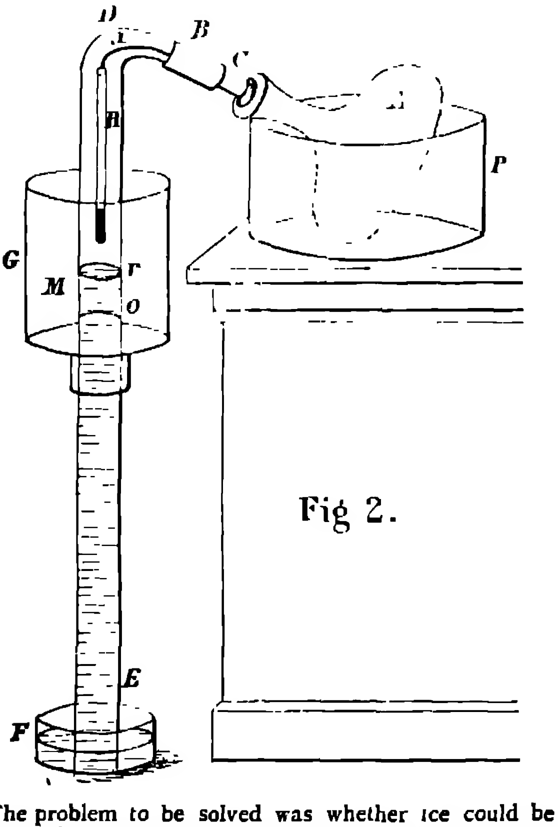


Fig 2.

The problem to be solved was whether ice could be prevented from melting by maintaining the pressure below its critical pressure, *i.e.* the tension of its vapour at the melting-point, and that whatever the intensity of the heat applied. Now the theory of critical pressure gives us no information as to whether the ice, on non-fusion, would or would not rise above its ordinary melting-point when strongly heated, but as this result had been previously attained in the case of mercuric chloride it appeared not impossible that the ice *might* become hot.

The question as to the rise of temperature of the ice above 0°, though at first but a side issue of the investigation, became from its more especial interest the chief object of inquiry, and the experiments which have been made and those which are at present in hand relate almost solely to this point.

The great difficulty to be overcome was to maintain the pressure in the containing vessel below 4 6 mm, *i.e.* the tension of aqueous vapour at the freezing-point, for it will be easily understood that if the ice be but slightly heated the quantity of vapour given off would soon be sufficient to raise the pressure above that point. After several fruitless attempts, the following plan, involving the principle of the cryophorus, was adopted:—A strong glass bottle, such as is used for freezing water by means of Carre's pump, was fitted with a cork and glass tube C (Fig 2) and the cork well fastened down by copper wire A and C were then filled with wet mercury (the water facilitating the removal of the air-bubbles) and C connected with the end of the tube D E by means of the stout india-rubber tubing B, a thermometer having been previously attached by the wire x to the lip of the tube at B. The tube D E was about one inch diameter, and about four feet long from the bend to the end E; after connection with C it was completely filled with mercury and the whole inverted over the mercurial trough F, as shown in the figure, when the mercury fell to O, the ordinary height of the barometer The mercury was run out of A by tilting up the bottle and inclining the tube D E By this means a Torricellian vacuum was obtained from A to O D was next brought to the vertical, and the bottle A placed in the trough P. A tin bottle G without a bottom was

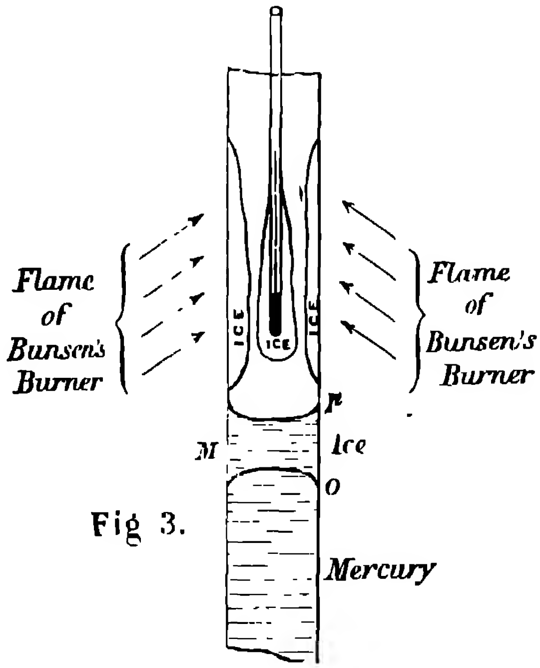


Fig 3.

fitted with a cork, so that it might slide somewhat stiffly along D E

To begin with, the tin bottle was placed in the position G and filled with a freezing mixture of salt and ice. Some boiled water was then passed up into the tube D E, sufficient to form a column at M about two inches deep. The thermometer H had been previously arranged so that its bulb might be one or two inches above the surface of the water M The bottle A was next surrounded by a good quantity of freezing mixture, in order that any vapour given off from the water at M might be condensed in A as fast as it was formed, and thus the internal pressure might never be more than about 1 0 to 1·5 mm. When A had been sufficiently cooled, which required about fifteen minutes, the tin vessel G was slid down the tube D E, and its freezing mixture removed. The water at M had then solidified to a mass of ice, which on heating with the flame of a Bunsen's burner, melted either wholly or partially, and the liquid formed began at once to boil. The fusion commenced first at the bottom of the column of ice, whereas the upper part fused only with difficulty, and required rather a strong heat. The fusion in this case was probably due

to the steam evolved from the lower portions of the ice column being imprisoned and unable to escape, and hence producing pressure sufficient to cause fusion.

When the greater part of the ice had been melted, the tube was tightly clasped by the hand, the heat of which was sufficient to produce a somewhat violent ebullition. The liquid in boiling splashed up the side of the tube and on to the bulb of the thermometer, where it froze into a solid mass, as represented in Fig 3. By this means the ice was obtained in moderately thin layers The tube at the points indicated by the arrows was then strongly heated by the flame of a Bunsen's burner with the following results :—The ice attached to the sides of the tube at first slightly fused, because the steam evolved from the surface of the ice next the glass, being imprisoned between the latter and the overlying strata of ice, could not escape, and hence produced pressure sufficient to cause fusion, but as soon as a vent-hole had been made fusion ceased, and the whole remained in the solid state, and neither the ice on the sides of the tube nor that on the bulb of the thermometer could be melted, no matter how great the heat applied, the ice merely volatilising without previous melting ; thus proving that if the pressure be maintained below the critical pressure the ice cannot be melted. In different experiments the thermometer rose to temperatures considerably above the melting- and even the boiling-point of water, the highest temperature reached being 180° C, when the ice had either wholly volatilised or had become detached from the bulb of the thermometer, but in no case did the ice attached to the thermometer melt when these temperatures had been reached, as erroneously stated in some reports of my experiments The ice attached to the thermometer did not partially fuse at the commencement of the heating, because, the heat reaching the outer surface of the ice first, evaporation could take place from a free surface and the vapour not become imprisoned, as was the case with the ice attached to the sides of the tube. These experiments were repeated many times with the same result, except in one case in which the heat applied had been very strong indeed, and the ice attached to the sides of the tube fused completely On removing the lamp however for a few seconds the water froze again, notwithstanding that the portion of the glass in contact with it was so hot that it could not be touched without burning the hand

The chief conditions necessary for success appear to be (1) that the condenser A (Fig 2) is sufficiently large to *maintain* a good vacuum For the size of apparatus given above it ought to be about 1 litre, (2) that the ice is not in too great mass, but arranged in thin layers. Nor must it expose too great a surface for evaporation, otherwise the steam is liable to be evolved more quickly than it can be condensed, and the pressure would therefore rise above the critical pressure. Further, in the case where the heat is applied to the under surface of the layers of ice, the latter must be sufficiently thin to allow of a vent-hole being formed for the escape of the steam coming from below, if not, fusion occurs When the heat is applied to the free surface of the ice the layers may be much thicker In order to get the temperature to rise above the ordinary melting-point of ice, it is necessary that a very strong heat be applied, otherwise all the heat is used to convert the ice into steam without raising its temperature; it must in fact be applied more quickly than it can be absorbed for changing the state of aggregation. Prof McLeod, who has written to me to the effect that he has been unable to obtain any symptoms of hot ice, has failed I believe on account of not having complied with this condition Dr. Lodge, in an admirable and very clear letter to NATURE (vol. xxiii. p. 264), has endeavoured to explain why "hot ice" is possible, and also points out the absolute necessity for supplying the heat more rapidly than it can be absorbed by the vapour.

Now the question arises, Does the thermometer in the above experiments indicate the real temperature of the ice? It has been said by Prof Stokes that the ice, though attached to the thermometer, is not at the same temperature as the latter, and that the action is really as follows. The pressure is reduced till the boiling-point falls below the melting-point, and when heat is applied to the ice in contact with the glass tube a film passes into vapour, and thus prevents the ice from touching the glass except at a few isolated points The great latent heat of evaporation prevents the ice from rising to its ordinary melting-point, and hence no fusion occurs The ice is only heated —except at the few isolated points of contact—by radiation, and therefore comparatively slowly A portion of the heat passes through the ice and falls on the thermometer inside, and the latter rises in temperature, this causes the formation of a film of vapour between the ice and the bulb of the thermometer, so that the latter is in contact with the ice at a few points only, and therefore hardly any heat passes by conduction to the ice

As under the circumstances of the case this appeared the most probable explanation of the phenomena, it was of great importance to show by other and more conclusive experiments whether the ice really was hot or not For this purpose Prof Roscoe suggested the most decisive test which could be applied, viz, dropping the supposed hot ice into water and observing the amount of heating or cooling of the latter. Up to the present I have only had the opportunity of completing two of these calorimetrical determinations, and the second of these was merely a qualitative experiment, as the weight of ice dropped in could not be found, owing to a small quantity of the water having been jerked out of the calorimeter the moment the ice entered it In both experiments, however, the water distinctly increased in temperature, and therefore showed that the ice must have been above 80° C. In the complete experiment the weight of ice dropped into 185 grammes of water was 1 3 grammes, and the rise in temperature 0 2° C, showing that the temperature of the ice was 122° C From the nature of the experiment the weight of ice which could be dropped into the calorimeter was only small, and though the rise in temperature was but slight, yet if the ice had been at 0° a relatively large cooling ought to have been observed. Great care was taken to avoid any error in the determinations The thermometer employed was graduated so as to allow of a difference of 0 05° C being easily detected, two observers read off the temperatures independently of one another, the calorimeter was inclosed in several casings and filled with the water to be used some hours before the experiment, so that it might have the temperature of the room, whilst the time which elapsed between the readings of the thermometer would not be more than about fifteen seconds, and finally the calorimeter was not brought into position to receive the ice till the source of heat had been removed. To place the point beyond doubt, however, several additional and perfectly satisfactory calorimetrical determinations are necessary, and if possible on a larger scale Such experiments are at present in hand In the meantime I would make the following remarks in favour of the high temperature of the ice If the ice is not really hot, notwithstanding that the thermometer indicates say a temperature of 120° C, how is it possible for the ice to hang on to the thermometer? For if it be separated from the bulb by a layer of steam, it cannot hang by steam, it would at once become detached from the thermometer. The thermometer was chosen so that the bulb was of the same, and in most cases of a less, diameter than the stem, so that there was nothing to prevent the ice falling away if so inclined.

In some cases I have had thin plates of ice attached by their edge at right angles to the stem of a paper scale thermometer for a considerable time without being

detached or melting, notwithstanding the temperature was so high that the paper scale at that portion of the stem to which the ice clung was charred, this was the case in one of the experiments shown at the Chemical Society. In another instance I have had a thin circular piece of ice attached to the otherwise bare bulb of the thermometer, and though this piece was very thin and no more than about 2 mm. diam, it took fully one minute or more to volatilise, notwithstanding the thermometer indicated a mean temperature of about 70° C, and the surrounding tube was very hot. If the ice were not capable of being heated above its melting-point, a piece so small as that referred to would, I think, under these circumstances have fused or volatilised almost instantaneously. If the ice be really above 80° C it ought to melt suddenly and at once on discontinuing the heat and increasing the pressure, and this I have in one or two instances found to be the case. Thus in one experiment a beautiful rod of ice nearly six inches long and about half an inch diameter was attached to a glass rod suspended in the apparatus described above and heated very strongly with a large Bunsen's burner for several minutes, the pressure was then let in, when the ice at once fell off the rod into the mercury trough below, melting completely, and as far as could be seen even before it reached the mercury. Careful observations have also been made to see whether any cavity could be detected between the ice and the hot thermometer when the latter was only partially covered with ice, and indicated a high temperature, but such could not be seen either with ice or mercuric chloride. In both cases the substance appeared to rest in actual contact with the bulb of the thermometer, in this respect differing from camphor, which does exhibit such a space. I have however never been able to get camphor above its ordinary melting-point, though by reducing the pressure below 400 mm., it solidifies while boiling, and cannot be re-melted unless the pressure be increased.

One curious point about the ice experiments is the comparative slowness with which the ice appears to evaporate, though the surrounding tube is very strongly heated.

In conclusion, I need hardly say that it is highly desirable that my results should be confirmed by other observers. THOS. CARNELLEY

TELE-PHOTOGRAPHY

WHILE experimenting with the photophone it occurred to me that the fact that the resistance of crystalline selenium varies with the intensity of the light falling upon it might be applied in the construction of an instrument for the electrical transmission of pictures of natural objects in the manner to be described in this paper.

In order to ascertain whether my ideas could be carried out in practice, I undertook a series of experiments, and these were attended with so much success that although the pictures hitherto actually transmitted are of a very rudimentary character, I think there can be little doubt that if it were worth while to go to further expense and trouble in elaborating the apparatus excellent results might be obtained.

The nature of the process may be gathered from the following account of my first experiment. To the negative (zinc) pole of a battery was connected a flat sheet of brass, and to the positive pole a piece of stout platinum wire; a galvanometer was interposed between the battery and the brass, and a set of resistance-coils between the battery and the platinum-wire (see Fig. 1, where B is the battery, R the resistance, P the wire, M the brass plate, and G the galvanometer). A sheet of paper which had been soaked in a solution of potassium iodide was laid upon the brass, and one end of the platinum wire previously ground to a blunt point was drawn over its surface. The path of the point across the paper was marked by a brown line, due, of course, to the liberation of iodine. When the resistance was made small this line was dark and heavy; when the resistance was great the line was faint and fine, and when the circuit was broken the point made no mark at all. If we drew a series of these brown lines parallel to one another, and very close together, it is evident that by regulating their intensity and introducing gaps in the proper places any design or picture might be

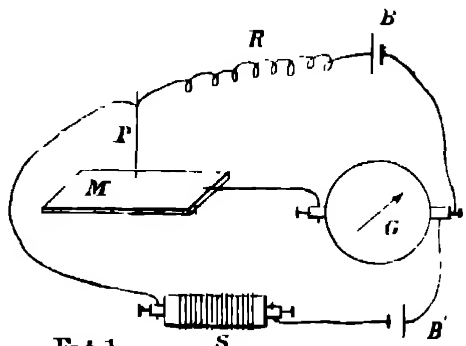


Fig. 1.

represented. This is the system adopted in Bakewell's well-known copying telegraph. To ascertain if the intensity of the lines could be varied by the action of light, I used a second battery and one of my selenium cells, made as described in NATURE, vol. xxiii. p. 58. These were arranged as shown in Fig. 1, the *negative* pole of the second battery, B', being connected through the selenium cell S with the platinum wire P, and the positive pole with the galvanometer G. The platinum point being pressed firmly upon

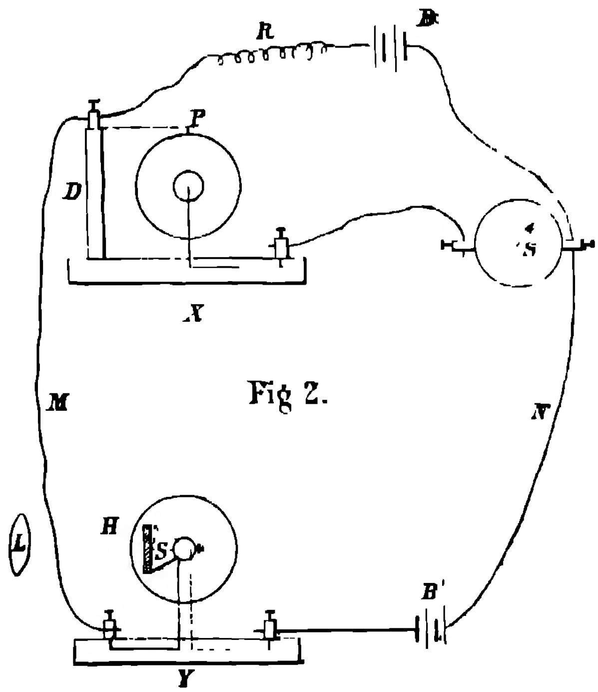


Fig. 2.

the sensitised paper and the selenium exposed to a strong light, the resistance R was varied until the galvanometer needle came to rest at zero. If the two batteries were similar this would occur when the resistance of R was made about equal to that of the selenium cell in the light. The point now made no mark when drawn over the paper. The selenium cell was then darkened, and the point immediately traced a strong brown line, a feeble light was next thrown upon the selenium, and the intensity of

the line became at once diminished. Lastly, a screen of black paper, having a large pin-hole in the middle, was placed at a short distance before the selenium, and the image of a gas-flame was focussed upon the outer surface of the screen, a small portion of the light passing through the pin-hole and forming a luminous disk upon the selenium. The galvanometer was again brought to zero, and, as before, the platinum point made no mark. When however the gas-flame was shaded a firm and steady line could be drawn, and when the light was interrupted by moving the fingers before the pin-hole a broken line was produced. For this last operation a very sensitive paper was required, and it was found necessary to move the platinum point slowly.

In consequence of the very satisfactory results of these preliminary experiments I made a pair of "tele-photographic" instruments, of which the receiver was slightly modified from Bakewell's form. They are of rude construction, and I shall say nothing more about them except that on January 5 they produced a "tele-photograph" of a gas-flame, which was good enough to induce me to make the more perfect apparatus now to be described.

The transmitting instrument consists of a cylindrical brass box four inches in diameter and two inches deep, mounted axially upon a brass spindle seven inches long, and insulated from it by boxwood rings. The spindle is divided in the middle, its two halves being rigidly connected together by an insulating joint of boxwood. One of the projecting ends of the spindle has a screw cut upon it of sixty-four threads to the inch, the other end is left plain. The spindle revolves, like that of a phonograph, in two brass bearings, the distance between which is equal to twice the length of the cylinder, and one of the bearings has an inside screw corresponding to that upon the spindle. At a point midway between the two ends of the cylinder a hole a quarter of an inch in diameter is drilled, and behind this hole is fixed a selenium cell, the two terminals of which are connected respectively with the two halves of the spindle. The bearings in which the spindle turns are joined by copper wires to two binding screws on the stand of the instrument. The transmitter thus described is represented in diagrammatic section at Y (Fig. 2), where H is the hole in the cylinder and S the selenium cell.

The receiving instrument, shown at X (Fig. 2) contains another cylinder similar to that of the transmitter, and mounted upon a similar spindle, which however is not divided, nor insulated from the cylinder. An upright pillar D, fixed midway between the two bearings, and slightly higher than the cylinder, carries an elastic brass arm fitted with a platinum point P, which presses normally upon the surface of the cylinder. To the brass arm a binding screw is attached, and a second binding screw in the stand is joined by a wire to one of the brass bearings.

To prepare the instruments for work they are joined up as shown in Fig. 2, two batteries, a set of resistance coils, and a galvanometer being used, in exactly the same manner as in the preliminary experiments. The cylinder of the transmitting instrument Y is brought to its middle position, and a picture not more than two inches square is focussed upon its surface by the lens L. The pictures upon which I have operated have been mostly simple geometrical designs cut out of tinfoil and projected by a magic lantern. It is convenient to cover a portion of the cylinder with white paper to receive the image. The comparatively large opening H is covered with a piece of tin-foil, in which is pricked a hole which should be only just large enough to allow the instrument to work. [I have not been able to reduce it below one-twentieth of an inch, but with a more sensitive selenium cell it might with advantage be smaller.] The hole is then brought, by turning round the cylinder, to the brightest point of the picture, and a scrap of sensitised paper, in the same condition as that to be used, being placed under the point P of the receiver, the resistance R is adjusted so as to bring the galvanometer to zero. When this is accomplished the two cylinders are screwed back as far as they will go, the cylinder of the receiver is covered with sensitised paper, and all is ready to commence operations.

The two cylinders are caused to rotate slowly and synchronously. The pin-hole at H in the course of its spiral path will cover successively every point of the picture focussed upon the cylinder, and the amount of light falling at any moment upon the selenium cell will be proportional to the illumination of that particular spot of the projected picture which for the time being is occupied by the pin-hole. During the greater part of each revolution the point P will trace a uniform brown line, but when H happens to be passing over a bright part of the picture this line is enfeebled or broken. The spiral traced by the point is so close as to produce at a little distance the appearance of a uniformly-coloured surface, and the breaks in the continuity of the line constitute a picture which, if the instrument were perfect, would be a monochromatic counterpart of that projected upon the transmitter.

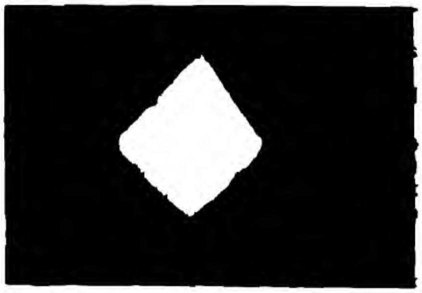


FIG. 3.—Image focussed upon Transmitter.

An example of the performance of my instrument is shown in Fig. 4, which is a very accurate representation of the manner in which a stencil of the form of Fig. 3 is reproduced when projected by a lantern upon the transmitter. I have not been able to send one of its actual productions to the engraver, for the reason that they are exceedingly evanescent. In order to render the paper sufficiently sensitive, it must be prepared with a very strong solution (equal parts of iodide and water), and when this is used the brown marks disappear completely in less than two hours after their formation. There is little doubt that a solution might be discovered which would give permanent results with equal or even greater sensitiveness, and it seems reasonable to suppose that some of the unstable compounds used in photography might be found suitable, but my efforts in this direction have not yet been successful.

FIG. 4.—Image as reproduced by Receiver.

In case any one should wish to repeat the experiments here described a few practical hints may be useful. In order that as large a portion as possible of the current from the battery B′ (which is varied by the selenium cell)

may pass through the sensitised paper, the resistance R must be high; the E M F of the battery B must therefore be great, and several cells should be used.

An electromotive force is produced by the action of the platinum point, and the metal cylinder upon the sensitised paper, and the resulting current is for many reasons very annoying. I have got rid of this by coating the surface of the cylinder with platinum foil

Stains are apt to appear upon the under-surface of the paper, which sometimes penetrate through and spoil the picture. They may be prevented by washing the surface of the cylinder occasionally with a solution of ammonia.

Slow rotation is essential in order both that the decomposition may be properly effected and that the selenium may have time to change its resistance The photophone shows that *some* alteration takes place almost instantaneously with a variation of the light, but for the greater part of the change a very appreciable period of time is required

The distance between the two instruments might be a hundred miles or more, one of the wires, M, N, being replaced by the earth, and for practical use the two cylinders would be driven by clockwork, synchronised by an electromagnetic arrangement. For experimental purposes it is sufficient to connect the two spindles by a kind of Hooke's joint (some part of which must be an insulator), and drive one of them with a winch-handle

The instrument might be greatly improved by the use of two, four, or six similar selenium cells and a corresponding number of points If two such cells were used the transmitting cylinder would have two holes, diametrically opposite to each other, with a selenium cell behind each. A second point would press upon the under surface of the receiving cylinder, and be so adjusted that the lines traced by it would come midway between those traced by the upper point Four or six selenium cells could be similarly used The adjacent lines of the picture might thus be made absolutely to touch each other, and moreover the screw upon the spindles might be coarser, which for obvious reasons would be advantageous A self-acting switch or commutator in each instrument would render additional line-wires unnecessary.

SHELFORD BIDWELL

NOTES

THE Murchison medal of the Geological Society has this year been awarded to Prof Geikie

THE Associateship of the Institute of Chemistry, along with the prize of 50*l*., offered by Prof. Frankland for the "best research involving gas analysis," has been awarded to Mr. Frank Hatton, of 14, Titchfield Terrace, Regent's Park, student in the Royal School of Mines, South Kensington.

WE regret to record the death, at the age of seventy-seven years, of Mr. John Gould, F.R S., the eminent ornithologist We hope to give some account of his life and work in our next number.

A REMARKABLE discovery has been made by Mr. Alex. Adams, one of the technical officers of the Post Office Telegraph Department. It is the existence of electric tides in telegraph circuits. By long-continued and careful observations he has determined distinct variations of strength in those earth currents, which are invariably present on all telegraphic wires, following the different diurnal positions of the moon with respect to the earth. He will read a paper on the subject at the meeting of the Society of Telegraph Engineers to-night.

MR JOSEPH THOMSON has, we understand, received the offer of an advantageous post under the Sultan of Zanzibar, which no doubt he is likely to accept. Mr Thomson's work will be mainly that of geological surveying in the region of the Rovuma River, and the Sultan has offered him every facility for carrying on the work. The Sultan deserves every credit for showing such enterprise, and we have no doubt that Mr. Thomson will be able to do work of great scientific value.

AT the Royal College of Surgeons Prof W. K. Parker, F.R.S, will give nine lectures on the Structure of the Skeleton in the Sauropsida, on Mondays, Wednesdays, and Fridays, February 11, 16, 18, 21, and 23, at 4 p m Prof W H Flower, LL D, F.R.S, will give nine lectures on the Anatomy, Physiology, and Zoology of the Cetacea, on Mondays, Wednesdays, and Fridays, February 28, March 2, 4, 7, 9, 11, 14, 16, and 18, at the same hour.

WE are glad to learn that the new 23-inch object-glass of Prof C. A. Young of Princeton, N.J., is completed. Prof Young has tested it at Cambridge, Mass., and finds it very fine, he hopes by and by to do some good stellar spectroscopic work with it The mounting is well under way, and it is expected that the instrument will be in place next autumn.

MR LAMONT YOUNG, the Government geologist of New South Wales, has suddenly and mysteriously disappeared, and foul play is suspected. Mr Young arrived safely at Bermagui, 180 miles south of Sydney, and at once set out to cross the bay in a boat. No news of him came in, and two days later his boat was found jammed among the rocks of the coast, ten miles north of the point from which he had started It was at first, and naturally, supposed that Mr. Young and his company had been drowned, and that his boat had drifted on shore A closer examination proved that the boat had been drawn carefully up on the coast, and that the party had dined after landing. Next some bullet holes were found in the boat, and this suggested the idea that the explorers had been attacked and murdered. But not a single mark of blood or additional trace of any violent assault could be discovered. The party were five in number, and the coast has been examined for traces or tidings of them in vain An official of the Mines Department has been assisted by detectives and by the boasted "black trackers," natives whose acuteness is seldom at fault in a case of this sort

PROF MCK HUGHES writes on Jannuary 27, suggesting the following scientific uses of the late severe weather:—When this frost breaks up and the frozen snow and ice begin to travel along our rivers to the sea there will be an opportunity of making observations upon several points upon which accurate information will be of use in seeking an explanation of some of the glacial and post-glacial phenomena of the British Isles, *e.g* (1) Dimensions of the ice floes; (2) whether they consist chiefly of frozen snow or solid ice, *i.e.* an approximate estimate of their specific gravity, (3) amount of material carried by them and dimensions of larger boulders, (4) whether any of these were dropped on to the floe from cliffs of glacial drift so as to give scratched stones and *remanié* drift in modern mud, (5) how far out to sea such floes have been traced with or without earth and stones, (6) salinity of the water where the observations were made, (7) transport of shore shells, &c., by ice; (8) crumpling of mud by impinging ice, (9) grinding of ice along bridge piers, and many similar observations which it will be useful to record.

THE great annual *soirée* at the Observatory of Paris has been a great success. Almost all the Cabinet ministers and M Gambetta were present. A plan was exhibited in the Astronomical Museum showing the present state of the Observatory, and what it will be when all the works for which credits have been voted shall be completed. A ball took place after a series of lectures and projections given in the *grande galerie*. One of the lecturers, M Bertus, exhibited magic mirrors, and reminded those present that in 1844 M. Mouchez, then a junior officer in the French naval service, brought home with him one of these mirrors from Japan, which was presented to the Academy

of Sciences by Arago. The *Comptes rendus* states that Arago was asked to inquire into the properties of this curious phenomenon, but it does not appear that he made any effort to comply with the request of the Academy.

AFTER a series of experiments which have proved successful, the Administration of French lighthouses has given an order to M. de Meritens to build six magneto electric machines for the three first lighthouses which are to be illuminated by electricity.

THE Chemical Section of the Russian Physico Chemical Society has, on the proposal and at the expense of Mr. V. J. Ragosine, established a competition for a prize of 750 metallic roubles (3000 francs) for the invention of a lamp intended to burn the heavy oils of petroleum (naphtha), *i.e.* the parts of the raw petroleum which distil after the kerosene or ordinary petroleum (density from 0·79 to 0·83 at 20° C.), as also astral oil (density 0·83 to 0·85 at 20° C.), but before the oils intended for greasing purposes (density about 0·88), *i.e.* oils whose density is from 0·85 to 0·88 at 20° C. The lamps ought (1) to be as simple as possible in construction, so that they may be easily manufactured and manipulated, (2) only glasses existing already in the retail trade to be used, if they are used at all, (3) to burn, without giving either soot or smell, the heavy oils whose density is at least between 0·865 and 0·875. The lamps must be sent in by January 12, 1882, and three specimens of each should be sent, accompanied by a detailed description in Russian, French, German, or English. There is no restriction as to nationality. Further information may be obtained from the Secretary of the Society, St. Petersburg.

WE would call the attention of our readers to a very valuable and ingenious instrument which has been recently introduced by Messrs. Francis and Co., the Telegraph Engineers, Hatton Garden, London, for the purpose of receiving the "Greenwich Time Signal" at the various telegraph stations and offices of private firms who may be in communication with the Postal Telegraph Service. Hitherto the passage of the time-signal current at 10 a.m. along the wires gives no other indication of its presence than a deflection of the needle of ordinary instruments, and a corresponding movement of the armature of the Morse Ink-Writer and Sounder, so that unless a sharp look-out be kept with the eye constantly directed to the instrument, the actual time of signal may be lost, perhaps also again to be lost on the following day through similar accident. By the new instrument, however, the instant the current is sent the needle on its dial is deflected, and simultaneously a bell rings and continues to ring so long as the current is passing. The index-needle, or in other words the needle of the galvanometer, which is the principal feature of the invention, when deflected, presses against a small spiral spring surrounding the stops or ivory pins on the dial plate, and by this contact the galvanometer forms itself into a "relay" and brings a local battery in circuit with the bell, which is contained in the same instrument, so that when the first part of the time-signal is sent the needle is deflected, and at the same moment the bell rings; thus attention to the time is at once arrested. It should be mentioned that the resistance to the line, although low, is intended to be inserted only during the transmission of the time-signal, as by means of what is generally termed a "switch" the instrument is put on and off the circuit at will, and employed only during the time set apart for the transmission of the "Greenwich Time Signal." However feeble the current may be, the galvanometer is so sensitive that a deflection of its needle is absolutely certain, whilst the bell cannot fail to answer to the power of its local battery. We are informed that not only is Messrs. Francis and Co.'s new instrument capable of doing what we have already stated, but it may be made available for communication from different parts of the building, an advantage which is certain to be recognised and approved by many conducting large business establishments, where the saving of time in conveying messages and giving orders is a matter which is not unfrequently of great importance.

A. P. S. WRITES:—During the late severe frost we had a number of bottles broken in our laboratory by the freezing of their contents, and it is curious to observe what salts tend to prevent such an occurrence. Out of thirty sets of reagents the following were destroyed:—27 ammonium oxalate, 7 calcium sulphate, 8 potassium ferrocyanide, 1 lead acetate. It is remarkable that not one bottle of lime-water was frozen. That calcium sulphate, which only contains $\frac{1}{500}$th of solid, should freeze, is not astonishing, but the ammonium oxalate bore away the palm with ease, although the amount dissolved was considerable. A single bottle of saturated solution of alum was broken, also one of mercuric chloride. A curious thing happened to one bottle, which shows, I think, that ice does not expand suddenly when it freezes. I unstoppered a bottle of Am_2O that was still liquid, when the contents immediately solidified in my hand, without bursting the bottle. The next day I found the ice had protruded 3½ inches from the neck of the bottle, carrying the stopper at its extremity.

THOSE who wish to see women have every fair play in the struggle for existence may be interested to know that at 399, Edgeware Road, Mme. Lina from Geneva is prepared to do good work as a practical watchmaker and jeweller.

A NUMBER of holes of the same description as those which have been observed at Blackheath have been opened in several parts of Paris. These enigmatical holes are several yards wide, long, and deep. Men of science are trying to solve the mystery of their formation.

A VERY satisfactory report was given at the recent annual meeting of the Birmingham Natural History Society, which now has apartments in Mason's College. The number of members is 382.

MR. J. B. JORDAN has issued a little pamphlet giving an account of his glycerine barometer, with plate and tables of correction for temperature. Stanford is the publisher.

UNDER the title of "All about Cardamoms, Botanical Descriptions, Commercial Uses, and Modes of Cultivation," a pamphlet of forty closely-printed pages has recently been issued in Colombo from the office of the *Ceylon Observer*. In this useful little pamphlet nothing new or original is professed to be given, it is simply a compilation of all matter bearing on the subject collected from all available sources, each article being printed in its entirety and its source acknowledged. Thus we find the article on Cardamoms from the latest edition of the *Encyclopædia Britannica*, Fluckiger and Hanbury's *Pharmacographia*, Bentley and Trimen's *Medicinal Plants*, and many others. In this arrangement there is of course much repetition of the same matter, but the idea is good as bringing together all that has been published on a given subject which is frequently scattered through many, and often inaccessible publications.

THE works for the Paris Exhibition of Electricity will soon begin. A viaduct will be built for the English electrical railway by Siemens, which will convey visitors from the Place de la Concorde to the Palais de l'Industrie. The internal arrangements will only be made at the end of the Art Exhibition, which will take place from May to July. The French exhibitors of the electric light have come to an agreement in order to combine for the illumination of the nave and other parts. They are trying to obtain from the High Commission an indemnity for their working expenses. It is desirable that the English Government appoint without delay an agent on behalf of the intended English exhibitors, who may be numerous, even in the light department.

ANOTHER slight shock of earthquake was felt at Berne on the night of the 1st inst. Fresh earthquake shocks are reported from Agram, where shocks were observed on January 25 at 1h 15m (in the morning) 11h a m , on the night of January 26 at 11h. 28m , in the morning of January 31 at 3h , on January 3 at 3h (in the morning), 1h 15m , and 4h 13m. p m. In the night of January 27-28 shocks were felt at St Ivan, Zelina (Hungary) at 12h 52m , 3h 9m., 4h. 32m. On January 28 two shocks were felt at Gurkfeld (Carinthia) and neighbourhood at 8h 50m p m , direction north west to south-east. Earthquakes were also noticed on January 25 at Venice, Bologna, and Padua. In the night of January 3-4 shocks were observed in the regions of the Carinthian Alps, in Klagenfurt, at 2h. 22m. 25s , direction east to west, duration 5-6s. ; in Trieste at 2h. 24m , direction north-east to south-west, duration about 4s , at the same time shocks were felt in Laibach, in Gurkfeld, and in Czegled (Hungary)

AN examination has taken place at Brussels of the railway *employés*, in order to test their eyes. More than one twentieth of them have been found defective, and consequently will be discharged as being unable to fulfil their functions with a sufficient security for travellers

THE AURORA AND ELECTRIC STORM OF JANUARY 31

WE have received the following further communications on the recent brilliant display of aurora :—

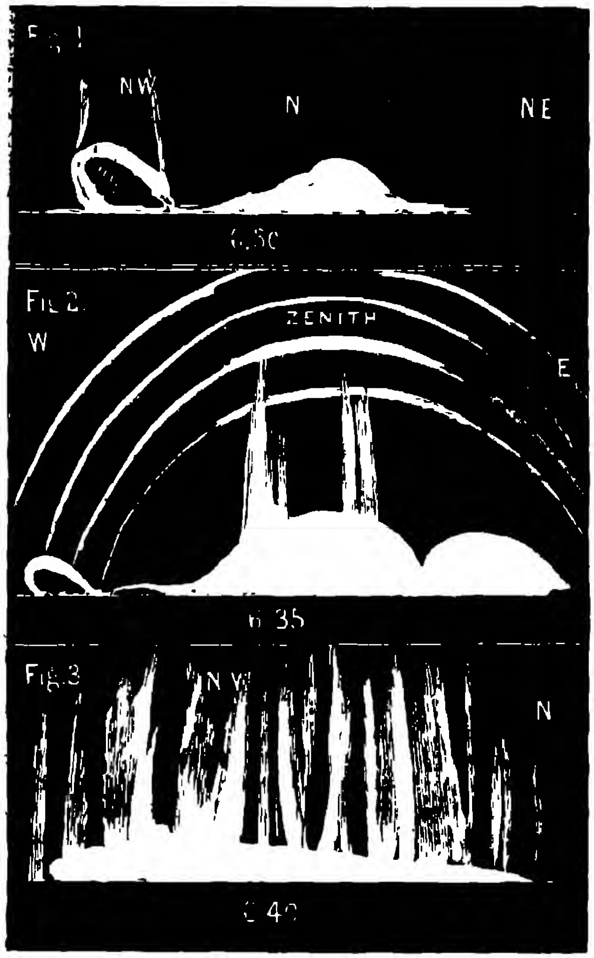
THE beautiful display of aurora on the evening of Thursday was accompanied by the usual earth-current disturbances They were evident over the whole of the United Kingdom Telegraphic lines were stopped, railway block-signals were disturbed, and all the usual accompaniments of these curious storms were observed.

The electric storm commenced about 3 p m , it reached a maximum at 6 40 p m , and disappeared about 9 p m It was renewed about 11 p m , and disappeared again about 1 a m on the next morning The currents attained an intensity that I have never before observed At Llanfair in Anglesey they measured 41 4 millivebers At Haverfordwest 30 millivebers , at Bristol 17 32 millivebers , in the Central Station, London, 11 millivebers , at Edinburgh 8 millivebers Now as working-currents vary from 5 to 10 millivebers, it is clear that these uninvited wanderers must play sad havoc with the working telegraphs In some instances they were strong enough to ring the bells used on railways. They are eliminated, where this can be done, by joining two wires in *metallic circuit*, and so excluding the earth. They were characterised by the usual reversals, the direction of the current changing slowly. The changes in direction and variation in strength were always observed on the southern lines first The line of maximum force commenced south-east to north-west, then passed south to north, and ended south-west to north-east

It is unfortunate that on such occasions the whole energies of the technical staff are taken up in maintaining communication, and that no time or means can be found to obtain accurate measurements The results however, such as they were, fully confirm my view that these storms are due to a violent disturbance of the distribution of electric potential on the earth's surface arising from violent changes in the electrification of the sun There was a violent disturbance in the sun's envelope on that day, as I learn from Mr Norman Lockyer, and I am looking with interest to some particulars of it

February 5 W. H PREECE

ON yesterday evening, January 31, a most brilliant display of the aurora was seen here, It was by far the finest I have seen, and others have expressed the same opinion At 6.25 p.m. I saw a considerable illumination on the northern horizon, and an outlying bright patch on the north-west having somewhat the appearance of the zodiacal light, as shown in the sketch, Fig 1 This outlying patch was distinctly in motion along the horizon towards the west, streamers from the horizon then shot up, and there appeared several arches of light apparently about the width of an ordinary rainbow, passing from the north west to north east points on the horizon , these arches gradually approached the zenith, and the southernmost from the east and west points of the horizon at last passed through it. Some of these arches are shown in Fig 2, but there were more visible In a few minutes, about 6 40, the arches faded, and there appeared, rather west of north, a mass of bright green light ; then the



streamers from the north lengthened out, as shown in Fig. 3, converging on the Pleiades, as near as I could judge , waves of red light commenced to pass upwards along them, and large sheets of light appeared to pass rapidly over the sky. The streamers gradually died away, leaving flashing lights near the horizon, which in their turn left a slight light over the northern horizon, which gradually faded away Mr Percy Smith made the sketches, but owing to the rapid changes their accuracy is only general Both he and I saw only one line in the spectrum in the usual place GEORGE M SEABROKE

Temple Observatory, Rugby, February 1

THE aurora observed during the evening of January 31 was accompanied by a magnetic perturbation, and although it was on a much smaller scale than that registered on August 12 to 14 last, a brief account of it may possess some slight interest to your readers

The magnets of all three instruments at Kew, the declination, bifilar, and balance magnetometers, began to be disturbed to a somewhat larger extent than usual about noon on the 31st, the

general tendency of the movement being an increase of westerly declination and of vertical force, whilst the horizontal force slightly diminished. Quicker movements of the needles commenced at 3 40 p.m Greenwich mean time, and from that hour until 8 33 p m oscillations followed each other at short intervals, although the magnets at no time appeared to be in the state of rapid vibration they were in during the afternoon of August 12

The principal deviations registered were as follows.—A large westerly deflection of the needle was recorded at 6 2 p.m, but the greatest excursion in that direction took place at 6 47 p m, at 7 12 p.m there was also another considerable westerly movement, followed by an easterly, which reached its maximum at 7.48 p m At 8 18 p.m it deviated again to the west, after which it returned to its approximately normal position at 8 33 p m An isolated deflection to the west at about 0 25 a m of February 1 wound up the storm

As regards force, the greatest changes of horizontal force occurred at about 6 p m, but they were not large in extent The vertical force curve moved in the extent of an augmented force beyond the limits of registration of the instrument between 4 20 and 5 32 p.m, and again between 6 2 and 6 45 p m The greatest movement in the direction of diminished force was at 8.12 p m.

The self-registering Thomson electrometer was not apparently affected by the aurora, the tension of atmospheric electricity being somewhat high positive at 9 a m, fell to a low positive tension at 2 p m, from which it rose gradually, although somewhat irregularly, until 8 p m, from that hour until 9 p m it was more disturbed, it then became more strongly positive, and remained so until the next day.

This want of accordance between the electrograph and magnetographs was also well marked during the August aurora, and would appear to prove that the electrical disturbances in the upper aerial strata during aurora do not cause changes of tension in the lower at all commensurable with those ordinarily produced by wind, snow, or rain G M WHIPPLE

Kew Observatory, February 2

THE commencement of the aurora consisted in the sudden lighting up of various portions of the sky by patches of white cloud, the northern horizon remaining constantly bright, and sending forth vertical streamers The general appearance of the heavens was that of a smooth lake ruffled here and there every other second by fitful gusts of wind

At 6.45 p m no ordinary clouds could be seen, but the flashes of white light were incessant, and varied continually in position. The light was strongest towards the north east horizon, but the whole of the north was well lit up from north-east to west

At 6 50 the streamers from the horizon increased in length and enveloped Polaris

At 6 55 the number of the streamers increased, and springing from the whole northern horizon, traversed an imperfect arch of white light which passed between ε and ζ Ursæ, and just below β and γ Ursæ Minoris

At 6.57 streamers 10° west of north passed from the horizon through the zenith, and the display was becoming very brilliant when I was obliged to enter the observatory for a few minutes to observe an eclipse of Jupiter's second satellite.

On returning to the garden at 7h 5m nothing remained of the aurora except patches of white light in different parts of the heavens, and a strong glow in the north Using a hand spectroscope I could see the green auroral line very strongly marked in every part of the sky, but no other line was visible.

There was no change in the phenomenon until 7h 45m, when a most brilliant cone of light of a reddish hue darted from between α and γ Aquarii, and developed almost immediately into a number of streamers which stretched out towards the Pleiades, this cluster being then some 30° from the zenith towards the west of south Other streamers also appeared near the horizon from the west point to east of north.

A lull succeeded this display, followed at 8h. 15m. by a grand outburst of red streamers from Aquarius and also from near Orion, both converging towards the Pleiades, those from Aquarius being the brightest. These were visible for at least six seconds along with other rays in the north-west

Cloud and haze were then collecting fast, and seven-tenths of the sky was already obscured. During this aurora the three self-recording magnets were very much disturbed, their movements being all rapid and extended During the whole of the morning of the 31st the declination was very irregular, but it was only about noon that the storm began in earnest From 3.30 until 9 p m the declination magnet was oscillating incessantly in long vibrations, several of fully a degree in extent, and between 7h 53m and 8 p m the western bearing increased by 1° 37′ 24″. Many other movements were nearly equally rapid, but not so extensive The movements of the horizontal force magnet were irregular from noon till after midnight, and they were very much exaggerated between 3h 45m p m and 8 15, the most rapid change was the remarkable diminution of 2·1 in. in the ordinate between 6 14 and 6 20 p m, this was preceded by a very quick rise, and followed by another nearly equally sharp

The vertical force magnet was most irregular between 2 p m on the 31st and 1 a m on the morning of the 1st The extreme maximum was attained at 4h 20m, and the two principal minima at 8h. 12m. p m, and at 12m after midnight The movement was most rapid at 8 p m, and this principal disturbance on all the curves coincided with the grand outbursts of red streamers which converged towards a point some 30° south of the zenith

Stonyhurst Observatory, February S J PERRY

MR T. DOWLEN has been again good enough to furnish me with notes on the aurora (of Monday last), as seen from Medway, Poynton, Cheshire

He first saw it at 6 30, it having been previously seen at 6 as a single shaft of white light At 6 30 it consisted of quickly-darting rays and waving curtains of light, filling almost the whole sky The horizon from extreme east to west was glowing, and from all this region streamers and waves of light shot upwards, meeting at or near the Pleiades, the rays often passing into Orion About 7 0 the light in the north-west extending from Venus to some distance north of the moon was rose-coloured, the other parts were white Now for a few minutes the display almost ceased and clouds began to come up in the north east, but the glow increased in brilliancy in the north and north-west, forming a concave mass of light, almost an inverted arch, and from this sprang a broad band of streamers filling up all the northern region, and reaching almost to the zenith This died down, and was succeeded by a similar display having a drifting movement westward, and a rose tint in the upper portion, which extended throughout it as it went westward This display also died out, and was followed by another similar band more to the west, white in colour

At 7 30 this was gone, and the whole aurora gradually grew smaller, the glow still remaining and giving feeble spurts until 8 30 About 9 30 the clouds were all gone, and Mr Dowlen saw that a long low arch of considerable width but tolerable brightness had been formed, the crown of the arch being just above Arided in Cygnus No streamers came from this arch, but there seemed to be a fringe of glow to it At midnight it faded away During the whole time there was no wind, and although there was a ground-frost, the temperature up to 9 o'clock, by thermometer without frame suspended at the end of a bough four feet from the ground, was 34° At 5 p m there had been a sharp shower of rain Mr Dowlen had no access to a spectroscope at the beginning Later on he saw only the citron line.

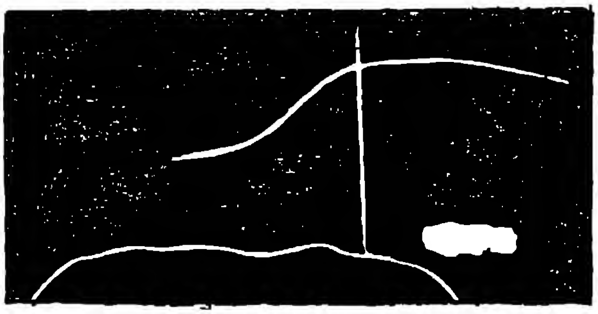
At Guildown the display was not seen, and some fog prevailed On the Monday morning at 8 a m a thermometer read 35° in a Stevenson cage four feet from the ground, while ice one-eighth of an inch thick lay on the garden paths

The shower of rain is interesting in connection with the suspicion that the aurora is generally formed in a mist or vapour region I have seen several eye-descriptions of this aurora, but no spectroscopic ones up to the present date

Guildown, February 4 J RAND CAPRON

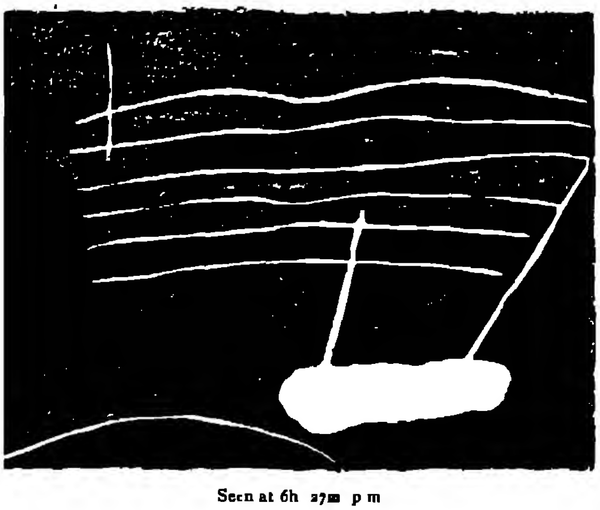
THIS was a display of aurora borealis having appearances quite new to me. There was a faint auroral glare at 6 p m; at 6h 15m. a confused but brilliant mass of light was situated west of Ursa Major, which moved quickly horizontally towards the west, there was also another mass of pink light in west, streamers shot up to the altitude of Cassiopeia 6h 24m the first-mentioned mass of light was now mostly to the west of Cassiopeia There was also another mass of light low down in north by east Stars shone brightly through the aurora, but without scintillation, and somewhat orange-coloured 6h 25m. brilliant streamers in north-east, a wavy arch stretched from west-north-west to east, its east end terminating in a black, almost perpendicular mass. There were also smaller black patches but quite distinct in character to the first-mentioned one The low dark segment had also a wavy edge, and there was a patch of strong light above

the north-east horizon. One very long streamer nearly due north rose from the dark segment and extended beyond the upper arch. At 6h. 27m. there were six well-formed arches, the upper one being that visible at 6h. 25m. They were all bent more or less, pointed towards east and west, and moved in a north current, i.e rising perpendicularly; and increasing rapidly in speed as they neared the zenith, and fading away on reaching a point some 20° S. (of the zenith). Their brilliancy was great, and a strong orange and red glare coloured the walls of the Observatory. A large intense patch of light was situated in north-east, from which streamers rose to the zenith, at 6h. 28m the whole of the



Seen at 6h 25m p m

arches (except that of the dark segment) had disappeared, occasional streamers and a strong glare continued, which at 7h 9m. was unusually brilliant, and red and orange in colour There were confused patchy lights, but no streamers. At 7h 10m these patches, together with their veil-like flames, passed to the south of the zenith, and formed a cupola which did not last a second, 7h 16m. the phenomenon was now all confusion, and so thin that there appeared to be no brilliancy, yet the time by a watch was readily seen, 7h 26m. very similar; 7h 39m still very bright, but settling down to the horizon, 8h 34m. the whole northern heavens up to the zenith was a glare of thin sheets of aurora, 9h 0m a glare alone remained.



Seen at 6h 27m p m

The streamers west of north all moved westerly, but not those in north-east, and this also applies to the patches of light, whilst the arches moved in a north current

The appearance was that of a luminous mist, and from the great speed when near the zenith was evidently much lower than usual. Flashes of thin light were very constant, appearing and disappearing incessantly

The patches of light were a close copy of the aurora of October 1848, i e. thirty two years three and a half months ago, and if this be the third return of that appearance the period would be eleven years and thirty-five days. E J. LOWE

Highfield House, Nottingham

AURORIC lights have been faint and scarce of late. There were some good ones a little before midnight on January 16, while on the 31st there was a most brilliant display, and of the observations made the following is an epitome.—

At 6 o'clock the sky was cloud-masked, with faint traces of orange-red columns between the north-west and north-east, coming up to 6.30 the clouds cleared away, and about 7 there were brilliant white lights to the north-west, making the night as light as day At 7.40 an oblique band of silver light extended from the west to the upper star of the Plough, and from it shot up horns towards the zenith, while the southern portion of the sky was a fiery red, with columns rising in places. At 7.48 there were remarkable silver lights in two oblique systems, one set rising between the south and west and going northward, and the other between the west and north-east and going southward. The first were steady and fairly constant, the second a series of rapid successive flashes, streaks, and glows. The systems of lights formed beautiful crosses at the zenith The flush lights passed round to the east, and all disappeared

At 7 53 fans of pencils of silver lights came up between the north-north west and north-north east, with at times disks at the north. Red, orange, and purple lights were rising at the same time in the southern portion of the heavens Subsequently the northward heavens usually were light and bright, with flushes of light at intervals, while the southern portion was dark, with columns of orange and reddish lights, some displays to the northward being very bright, of green, silver, and pink colours

At 9 30 there appeared an elliptic arch of silver light from the west-north-west by north to the north-east, which continued to 10 50, sometimes being much more distinct than at other times, its length being considerably contracted before it finally disappeared, the arch in general was white, but sometimes a silvery green. The under-sky was different shades of violet, the over-sky pale bright yellowish green. At times this arch was very similar to the pictures of auroræ given in books on Arctic travels.

At 10 45, a little before the arch finally disappeared, a brilliant display of silver pencils instantaneously sprang up between west north west and north-north east; those at the north north west by north being perpendicular, while those on either side sloped slightly, this lasted for nearly ten minutes, glow and pencils of pink lights were also coming up during the time, especially at the north west. Afterwards white lights appeared at times in the north heavens, and orange and purple in the south, up to 11.45, when there was another brilliant display of silver lights It began by pencils shooting up perpendicularly between the west to the north-east, which changed into a fan, the perpendicular lights only rising at the north-north-west, this lasted five minutes, the largest, most constant, and brilliant lights coming up at the north-west. At 12 there was the best display I had seen during the night. It consisted of pencils between the north-west and north north-east, some perpendicular, others fan-shaped, some steady, others in flashes; while at the same time there was a continuous upward stream of waves or lines of vivid white bright lights. The latter were so peculiar that I am at a loss to describe them sufficiently, while this display was in progress at the north, to the south-east, bounded by hard lines at the east and south, there were red lights rising. The white lights in about five minutes disappeared as suddenly as they came, but at 12 10 horizontal wavy white lights shot up in rapid succession between the north-west and north-north-east by north, followed by radiating pencils of white lights, all disappearing at 12 15 No very remarkable lights appeared afterwards up to 1 o'clock, when the last observations were made.

There were severe frosts on the nights of the 30 and 31st, while during the daytime on the 31st and February 1 there were remarkably hot suns. G. HENRY KINAHAN

Ovoca, co Wicklow

CLEAR starry night; slight frost. Shortly before 12 midnight beautiful auroras, when first observed, consisted of cloud-like white masses extending from about midway between Orion's belt and the Pleiades northward and eastward at about 30° above horizon, a little west of north, where the crown of the arc it formed lay below this arch of cloud-like masses (which at intervals shot up individually to the zenith); there were a number of pencils or rays of white light of varying length and intensity, some bright and sharply defined, and as a rule narrow and extending up to or beyond the cloud-like masses, others short, and some indistinct, all continually altering their position, boundaries, and intensities. While they were being watched, the cloud-like masses kept shooting upwards or horizontally like brush discharges.

Narrow sharply defined rays were remarked to shoot up on several occasions from the horizon, these gradually widened out, losing their sharp boundaries and becoming less distinct, some times behaving like the cloud-like masses or becoming intensified by a "brush discharge" occurring across them, at others they faded gradually away

At about 12 30 they had all disappeared, but a bright glow to the north horizon and faint glows at intervals over the sky between north and west.

It was not observed how far the discharges extended eastward.

24, Waterloo Road, Dublin GERARD A. KINAHAN

THE following details of this evening's remarkable aurora may be of interest to your readers. At 6 45 p m., while the new moon was setting, there was an appearance of a belt of luminous white cloud reaching along the northern and north-western horizon, giving indications of a tendency to divide into two separate parts, of which the western one had its upper surface parallel with the horizon, but that to the north was arched From both parts rays and vertical bands of white light began to shoot upwards, reaching nearly to the zenith, and becoming more and more distinct, especially in the north (as opposed to the north-west), and one long feathery streamer was very conspicuous, and reached in a slanting direction from a point on the horizon immediately under the Pole Star up to Capella.

In the meantime the cloud like appearance to the north-west had spread upwards over the heavens and assumed a dark ruddy colour, which gradually became brighter and more rosy, until it exactly resembled the light of dawn or sunset, which is sometimes reflected on the opposite side of the sky to the rising or setting sun At this time the northern heavens became suffused with white light extending over the space where the bands and rays had been appearing, which throbbed repeatedly and vividly like the electric discharge in a vacuum tube, continuing some minutes. This gradually faded away, and the pink light to the north west also disappeared by degrees, so that within twenty or twenty-five minutes from the commencement (say at about five or ten minutes past seven) there was little to be seen but a hardly noticeable light along the north horizon F. HORNER

Mells Park, Somerset, January 31

IT may interest your readers to know that the aurora of January 31 was distinctly seen by me here at about seven o'clock on that evening Such a sight is so uncommon in this part of London that I had some difficulty in convincing my friends that it was the *aurora* As I walked down the Wickham Road, Brockley, towards Greenwich, broad bands of light shot up from the northern regions and reached nearly to the zenith. Descending amongst the fog and smoke that overhung the lower parts of New Cross, the light gradually faded, and I saw no more of it.

W J SPRATLING

Aske's Hatcham Schools, Hatcham, February 4

THE aurora of January 31 was well seen here. It was at its brightest at 6.40 p m. It extended from about north west to nearly east In the north-west and to the north of the crescent moon there was a large irregularly shaped patch of *greenish* phosphorescent light. Then round from it towards the north rose *crimson* streamers towards the zenith The streamers continued round to the east nearly, still ascending zenithward, but white rather than crimson, between north east and east The streamers changed every instant, but the large greenish patch of light in the north-west was steady for some minutes.

It would be interesting to know whether observers in America noticed any unusual solar activity at the same absolute time as the aurora was occurring here, and also whether the magnetic elements in both hemispheres (north and south) showed disturbances in sympathy. D. TRAILL

Raleigh Lodge, Exmouth, February 4

GAS AND ELECTRICITY AS HEATING AGENTS[1]

II.

GAS engineers have been under the impression until now that a supply of cold air was favourable to the production of a brilliant flame. This is a misconception, which was very general also as regards the combustion of solid fuel in furnaces, until it was disproved by Stirling, by Neilson, and by the introduction of the Regenerative Gas Furnace. The "duplex burner" owes its brilliancy to the heating effect of the one burner upon the other; and my brother, Mr Frederick Siemens, has more recently constructed a burner in which the flame of the gas is reversed in its action in order to heat in its descent the ascending current of flame-supporting air

By the application of the principle of conduction before described, I obtain the hot-air current in a most simple manner without interfering with the free action of the flame. The construction of my burner will be seen from the diagram. A is an ordinary Argand burner, taking its supply of gas through the enlarged vertical copper tube B This copper pipe terminates in a rod C of highly conductive copper, which passes upward through the burner, and carries at its top a ball of porcelain or other refractory material. The rod is coated with platinum or nickel to prevent oxidation when heated (almost to redness) by the heat of the flame The tube B is armed with radial plates of copper presenting a considerable aggregate surface, and abutting externally against a covering of asbestos or other non-conductive material

The waste heat of the flame, or that portion of the heat produced in combustion which is not utilised in luminous rays, serves to heat the ball of refractory material D and the conductive rod C. The heat is thus transferred by conduction to the tube B, with its laminar radii, between the extensive surfaces of which currents of air are free to ascend toward the Argand burner. The air is thus heated to from 700° to 800° F before meeting the gas, and the ultimate temperature of the flame is increased to at least the same amount, causing a larger proportion of the heat developed in combustion to reach the point of luminous radiation.

But not only the quantity of light but its quality is improved by the higher temperature obtained

It may appear surprising, but it is a fact susceptible of accurate proof, that the light obtained in consumption of a given amount of gas may thus be increased by some 40 per cent., and that in this large proportion the deleterious influences connected with gas lighting may be diminished Gas will thus be better able to hold its position against its more brilliant rival the electric light, except for such large applications as the lighting of public halls and places, of harbours, railway stations, warehouses, &c, for which it is pre-eminently suited. Add to these improved applications of gas the ever-increasing ones for heating purposes, and I have only to express regret that I am not a gas shareholder.

If gas is to be largely employed, however, for heating purposes, it will have to come down in price, and considering that heating gas need not be highly purified, or possessed of high illuminating power, the time will come, I believe, when we shall have two services, one for illuminating, and the other for heating gas.

In many towns two systems of gas mains already exist, and it would only be necessary to appropriate the one for illuminating and the other for heating gas. The ordinary retorts could be used for the production of both descriptions of gas, it being well known that even ordinary coal will give up gases of high illuminating power during a certain portion of the time occupied in their entire distillation The gases emitted from the retort when first charged are to a great extent occluded gases of low illuminating power such as fire-damp or marsh-gas, and these should be turned into the heating mains In the course of half-an hour these occluded gases, together with the aqueous and other vapours, will have left the coal, which is then in the best condition to evolve olefiant gas and other gases rich in carbon, and therefore of high illuminating power The period during which such illuminating gases are emitted extends over probably two hours, after which the retorts should again be connected with the heating gas mains, until the end of the process. The result of this *modus operandi* would be that the illuminating gas supplied, say in London, from Newcastle coal would probably exceed 20 candle power, instead of 16 as at present, whereby the objectionable results of gas lighting would be greatly diminished, and there would be, say, an equal volume of heating gas available, consisting for the most part of marsh-gas, which, although greatly inferior to olefiant gas in illuminating effect, would be actually more suitable for heating purposes, because less liable to produce soot in its combustion

The total cost of production would not be increased by this separation of the gases, and the price might with advantage

[1] A lecture by C William Siemens, D C L., LL D, F R S, on January 27 in St Andrew's Hall, Glasgow, under the auspices of the Glasgow Science Lecture Association. Continued from p 329.

both to the supplier and to the consumer be so adjusted that the latter, while paying for his illuminating gas an increased price proportionate to the increase of illuminating power, would be furnished with a heating gas at greatly reduced cost, for the heating gas could be reduced in price in a much larger proportion than the illuminating gas would have to be raised, because it would not require the same purification from sulphur which renders illuminating gas comparatively costly. The enormous increase of consumption would moreover enable the gas companies to reduce prices all round very considerably without interfering with their comfortable revenues.

For large applications of heating gas to the working of furnaces and boilers, simpler means than the retort can be found for its production. I constructed a gas producer many years ago in connection with my Regenerative Gas Furnace, this I need not now describe in detail. In it all the carbonaceous matter of the coal is converted into combustible gas, the solid carbon yielding a supply of carbonic oxide, the resultant mixture of combustible gas contains a very large proportion averaging 61.5 per cent. of nitrogen, which swells its volume without in any way contributing to its heating power.

It has been my endeavour for some time to construct a gas producer which, without losing the simplicity of the first, should be capable of yielding a heating gas of superior calorific power. This producer consists of a wrought-iron cylindrical chamber, truncated downwards, and lined with brickwork. The fuel to be converted into gas is introduced through a hopper, and the cinder and ashes work out through the open orifice at the bottom.

Instead of a grating for the introduction of atmospheric air a current of heated air is brought in, either through the hopper or through the orifice at the bottom, and is discharged into the centre of the mass of fuel, the effect is the generation of a very intense heat at that point. The fuel, after its descent through the hopper, arrives gradually at this region of intense heat, and when subjected to it, parts with its gaseous constituents. At the point of maximum heat coke is consumed, producing carbonic anhydride, which, in passing through the considerable thickness of fuel surrounding this portion, takes up a second equivalent of carbon, and becomes changed into carbonic oxide. Here also the earthy constituents are for the most part separated in a fused or semi-fused condition, and in descending gradually reach the orifice at the bottom, whence they are removed from time to time. Air enters through the bottom orifice to some extent, causing the entire consumption of the carbonaceous matter, which may have got past the zone of greatest heat, water is also here introduced in a hollow tray, and after evaporation by the heat of the hot clinkers, passes upwards through the incandescent mass, and is converted by decomposition into carbonic oxide and hydrogen gas. The exit orifices for the gases are placed all round, near the circumference of the chamber, ascending upwards into an annular space, whence they are taken through pipes to the furnace or other destination.

The advantages connected with this *modus operandi* consist in the intensity of the heat produced within the centre of the mass, whereby the whole of the fuel is converted into combustible gases, with the least amount of nitrogen. The hydrocarbons formed in the upper portion of the apparatus have to descend through the hotter fuel below, and in so doing the tar and other vapours mixed up with them are decomposed, and furnish combustible gases of a permanent character.

The orifice at the bottom of the apparatus may be enlarged, and so arranged that, instead of ashes only being produced, coke may be withdrawn, and in this way a continuous coke oven may be constructed, which is at the same time a gas producer, or in other words an apparatus in which both the solid and gaseous constituents of the coal are fully utilised.

The intense heat in the very centre of a large mass of fuel has for its result a very rapid distillation, and thus one gas producer does the work of two or three gas producers of the type hitherto employed, this more concentrated action will moreover allow of the introduction of gaseous fuel, where want of space and considerations of economy have militated hitherto against it, and in favour of the ordinary coal furnace.

It has been already proved that steam boilers can be worked economically on land with gaseous fuel, and there is no reason that I know of why the same mode of working should not also be applied to marine boilers. The marine engine has, within the last fifteen years, been improved to an extent which is truly surprising: the consumption of coal, which at the commencement of that period was never less than 8 lbs. per HP., has been reduced by expansive working in compound cylinders to 2 lbs, or even less, per actual HP. The mode of firing marine boilers has, however, remained the same as it was in the days of Watt and Fulton. In crossing the Atlantic one may see a considerable number of men incessantly employed in the close stoke-hole of the vessel opening the fire-doors and throwing in fuel. Each charge gives rise to the development of great clouds of black smoke issuing from the chimney, to the great annoyance and discomfort of the passengers on deck. If, instead of this, the fuel could be discharged mechanically into one or more gas producers, the gaseous fuel produced would maintain the boilers at a very uniform heat, without necessitating the almost superhuman toil of the fireman, no smoke or dust would be emitted from the chimney, and a large saving of fuel would be effected.

This change would be specially appreciated by the numerous tourists visiting the Western Highlands. Speaking from my own experience on one occasion, I may say that the pleasure of a trip on the beautiful Loch Lomond was very seriously marred in consequence of the fumigation which my fellow passengers and myself had to endure.

The change from the use of solid to gaseous fuel would be the prelude probably to another, and still more important change, namely the entire suppression of the steam boiler. We are already in possession of gas-engines working at moderate expense as compared with small steam-engines, even when supplied with the comparatively expensive gas from our town gas-mains, and all that will be required is an extension of the principle of operation already established. The realisation of such a plan would of course involve many important considerations, and may be looked upon as one of those subjects the accomplishment of which may be left for the energy and inventive power of the rising generation of engineers.

Before leaving this branch of the subject I wish to call attention to a favourite suggestion which I had occasion to make some years ago. It consists in placing gas-producers at the bottom of the coal mines themselves, so that instead of having to raise the coal by mechanical power, the combustible gases ascending from the depth of the mine to the surface would acquire by virtue of their low specific gravity such an onward pressure that they could be conducted in tubes to distances of many miles, thus saving the cost of raising and transporting the solid fuel.

Glasgow with its adjoining coal-fields appears to me a particularly favourable locality for putting such a plan to a practical trial, and the well-known enterprise of its inhabitants makes me sanguine of its accomplishment. When thus applied with gaseous fuel, the town would not only be able to boast of a clear atmosphere, but the streets would be relieved of the most objectionable portion of the daily traffic.

I now approach another and the last portion of my address, the attainment of very intense degrees of heat either for effecting fusion or chemical decomposition. Although by means of the combustion of either solid or gaseous fuel heats are produced which suffice for all ordinary purposes, there is a limit imposed upon the degree of temperature attainable by any furnace depending upon combustion. It has been shown by Bunsen and by St Claire-Deville, that at certain temperatures the chemical affinity between oxygen on the one hand and carbon and hydrogen on the other absolutely ceases, and that if the products of combustion CO_2 and H_2O be exposed to such a degree of temperature they would fall to pieces into their constituent elements. This point of dissociation, as it is called, is influenced by pressure, but has been found for CO_2 under atmospheric pressure to be 2600° C (or 4700° Fahr.). But long before this extreme point has been arrived at, combustion is greatly retarded, and the limit is reached when the losses of heat by radiation from the furnace balance its production by combustion.

To electricity we must look for the attainment of a temperature above that of dissociation, and we have evidence of the early application of the electric arc to such a purpose. In 1807 Sir Humphry Davy succeeded in decomposing potash by means of an electric current from a Wollaston battery of 400 elements, and in 1810 he surprised the members of the Royal Institution by the brilliant electric arc produced between carbon points through the same agency.

Magneto-electric and dynamo-electric currents allow of the production of the electric arc much more readily and econo-

mically than by the use of Sir Humphry Davy's gigantic battery, and Messrs. Huggins, Lockyer, Liveing, and other physicists have taken advantage of the comparatively new method to advance astronomical and chemical research with the aid of spectrum analysis

My object is now to show that the heat of the electric arc is not only available within a focus or extremely contracted space, but that it is capable of producing such larger effects as will render it useful in the arts for fusing platinum, iridium, steel, or iron, or for effecting such reactions or decompositions as require for their accomplishment an intense degree of heat, coupled with freedom from such disturbing influences as are inseparable from a furnace worked by the combustion of carbonaceous material.

The apparatus which I employ to effect the electro-fusion of such material as iron or platinum is represented in the drawing It consists of an ordinary crucible of plumbago or other highly refractory material, placed in a metallic jacket or outer casing, the intervening space being filled up with pounded charcoal or other bad conductor of heat A hole is pierced through the bottom of the crucible for the admission of a rod of iron, platinum, or dense carbon, such as is used in electric illumination The cover of the crucible is also pierced for the reception of the negative electrode, by preference a cylinder of compressed carbon of comparatively large dimensions At one end of a beam, supported at its centre, is suspended the negative electrode by means of a strip of copper, or other good conductor of electricity, the other end of the beam being attached to a hollow cylinder of soft iron free to move vertically within a solenoid coil of wire, presenting a total resistance of about 50 units or ohms. By means of a sliding weight the preponderance of the beam in the direction of the solenoid can be varied so as to balance the magnetic force with which the hollow iron cylinder is drawn into the coil One end of the solenoid coil is connected with the positive and the other with the negative pole of the electric arc, and, being a coil of high resistance, its attractive force on the iron cylinder is proportional to the electromotive force between the two electrodes, or, in other words, to the electrical resistance of the arc itself

The resistance of the arc was determined and fixed, at well within the limits of the source of power, by sliding the weight upon the beam If the resistance of the arc should increase from any cause the current passing through the solenoid would gain in strength, and the magnetic force overcoming the counteracting weight would cause the negative electrode to descend deeper into the crucible, whereas, if the resistance of the arc should fall below the desired limit, the weight would drive back the iron cylinder within the coils, and the length of the arc would increase, until the balance between the forces engaged had been re-established.

Experiments with long solenoid coils have shown that the attractive force exerted upon the iron cylinder is subject only to slight variation within a range of several inches, which circumstance allows of a working range to that extent of nearly uniform action on the electric arc

This automatic adjustment of the arc is of great importance to the attainment of advantageous results in the process of electric fusion, without it the resistance of the arc would rapidly diminish with increase of temperature of the heated atmosphere within the crucible, and heat would be developed in the dynamo-electric machine to the prejudice of the electric furnace The sudden sinking or change in electrical resistance of the material undergoing fusion would, on the other hand, cause sudden increase in the resistance of the arc, with a likelihood of its extinction, if such self-adjusting action did not take place

Another important element of success in electric fusion consists in constituting the material to be fused the positive pole of the electric arc. It is well known that it is at the positive pole that the heat is principally developed, and fusion of the material constituting the positive pole takes place even before the crucible itself is heated up to the same degree This principle of action is of course applicable only to the melting of metals and other electrical conductors, such as metallic oxides, which constitute the materials generally operated upon in metallurgical processes In operating upon non-conductive earth or upon streams of gases it becomes necessary to provide a non-destructible positive pole, such as is supplied by the use of a pole of fused platinum, or iridium, or by a plumbago crucible. In working the electric furnace some time is taken up in the first instance in raising the temperature of the crucible to a considerable degree, but it is surprising how rapidly an accumulation of heat takes place. In using a pair of dynomo-machines capable of producing 70 webers of current with an expenditure of 7-horse power, and which, when used for purposes of illumination, produce a light of 12,000 candles, a crucible of about 8 inches in depth, immersed in a non-conductive material, has its temperature raised to a white heat in fifteen minutes, and 4 lbs. of steel are fused within another fifteen minutes, successive fusions being effected in somewhat diminishing intervals of time The process can be carried on on a still larger scale by increasing the power of the dynamo-machines and the size of the crucibles

The purely chemical reaction intended to be carried into effect within the crucible might be interfered with through the detachment of particles from the dense carbon used for the negative pole, although its consumption within a neutral atmosphere is exceedingly slow To prevent this I have used, both in this connection and also in the construction of electric lamps, a water pole, or tube of copper, through which a current of water circulates, so that it yields no substance to the arc. It consists simply of a stout copper cylinder closed at the lower end, having an inner tube penetrating to near the bottom for the passage of a current of water into the cylinder, which water enters and is discharged by means of flexible india-rubber tubing This tubing being of non-conductive material, and its sectional area small, the escape of current from the pole to the reservoir is so slight that it may be neglected On the other hand some loss of heat is incurred, through conduction, with the use of the water pole, but this loss diminishes with the increasing heat of the furnace, inasmuch as the arc becomes longer, and the pole is retired more and more into the crucible cover

In the experiments which I shall now place before you the current which has supplied the one electric lamp in the centre of the hall will be diverted by means of a commutator through the electric furnace After it has been active for five minutes to warm the crucible, I shall charge it with 8 lbs of broken steel files, which I shall endeavour to melt and pour out into an ingot mould before your eyes.

By some obvious modifications of this electric furnace it can be made available for a variety of other purposes where intense heat is required combined with immunity from disturbing chemical actions By piercing a number of radial holes through the sides of the chamber, and introducing the ends of wires through the same, an excellent means is provided of heating those wire ends very rapidly, without burning them, for the purpose of welding them together The electrical furnace will also be found useful, I believe, in the hands of the chemist to effect those high temperature reactions between gaseous bodies which require the employment of temperatures far exceeding the hitherto available limits, and will thus increase the area of available reactions at his disposal for the attainment of either scientific or practical ends

I have endeavoured to compress within the limited space of a single lecture, subject matter that might occupy the close attention of the student for weeks or months, and I may therefore be pardoned if I have failed to convey to you more than a very rough outline of what may be accomplished by the judicious use of gaseous fuel, and of the electric current, as heating agents The one purpose that has been foremost in my mind in preparing this lecture, has been to make war upon the smoky chimney, which, so far from being a necessity under any circumstances whatever, should be regarded only as a remnant of that stage of our industrial and social progress which satisfied with the attainment of certain ends, could afford to neglect the economical and sanitary conditions under which those ends were accomplished

The Exhibition which has lately been held in this city of appliances for heating and illuminating by means of gas and electricity, in which your President, my esteemed friend, Sir William Thomson, took so prominent a part, as he does in everything tending towards the advancement of human knowledge and well-being—proves how deep is the interest felt amongst you in those very questions with which I have had to deal this evening

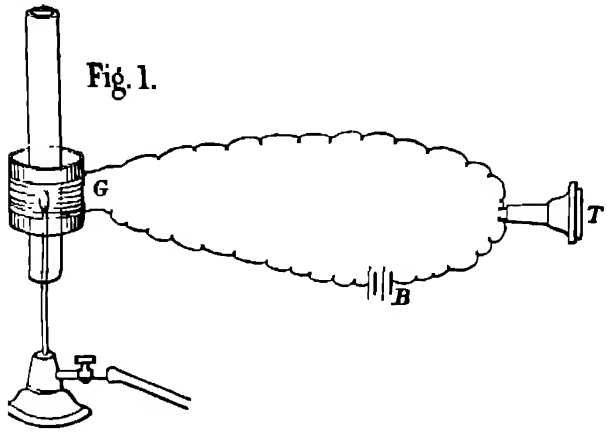
And so I thought you might not be disinclined to give attention once more to a particular view of the question, which happens to be the result of the independent labour of one who may claim at any rate to have given a life-long attention to the subject.

PHOTOPHONE EXPERIMENTS

MR. ANDREW JAMIESON, C.E., Principal of the Glasgow Mechanics Institution, sends us an account of the following experiments on the photophone, shown by him at a lecture delivered by him on January 19, before the Glasgow Philosophical Society, on the history of selenium.

The effects of light and heat on the conductivity of selenium were shown by means of a simple and inexpensive form of "cell" joined up in a Wheatstone's Bridge with a reflecting galvanometer. The cell is constructed in the following way:—A piece of plate-glass or of a glass tube of about an inch diameter and about three inches long is chosen, and upon its exterior are tightly wound two separate parallel wires of No. 25 B.W.G., the wires themselves being of copper covered with silk or cotton. A red-hot iron or poker is then applied to the middle region of the coil of wire so as to burn off the insulating covering of silk

Fig. 1.



or cotton. The bare wires are cleaned, and the blank cell being raised to the proper temperature, vitreous selenium is rubbed on the wires so as to fill the narrow interspaces left by the removal of the silk covering. The selenium is afterwards annealed in the the usual fashion to render it more highly conductive. One of the cells thus used had resistances of 5740 and 3440 ohms respectively in the dark and in the light; but others have less resistances, one being as small as 500 ohms in the dark. The first-named cell (a flat one) was twenty-one days old, and had increased several thousand ohms in that time.

The musical note of a "singing flame" was reproduced in the telephone by means of one of the annular cells thus formed upon a glass tube in the following manner, suggested by Prof. Blyth (Fig. 1):—The cell, C, joined in circuit with a battery, B, and telephone, T, was placed outside entirely surrounding the glass tube in which a small gas-jet was "singing." Speech was afterwards reproduced by the arrangement shown in Fig. 2. At the

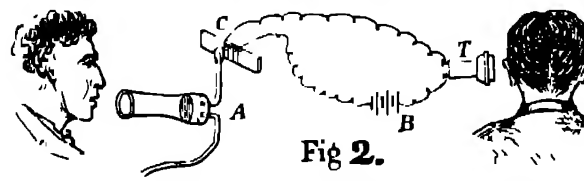


Fig. 2.

back conical mouthpiece which receives the voice is fixed a membrane of goldbeater's skin which forms the front of a chamber, A, into which gas is led, and from which a short tube leads to a small gas-jet, in the manner devised by Konig. Opposite the gas flame was placed the selenium cell in circuit with a battery of twenty cells and a distant telephone. There were thus eleven changes going on simultaneously:—

1. Muscular movement of speaker's vocal organs.
2. Vibration of air opposite speaker's mouth.
3. Corresponding vibrations of the thin membrane.
4. Variations of pressure controlling the supply of gas to jet.
5. Hence increase and decrease of gas-flame.
6. Increase and decrease of resistance of the selenium cell.
7. Rise and fall of battery current.
8. Increase and decrease of magnetism in magnet of telephone.
9. To-and fro movement of telephone disk.
10. Vibration of air opposite the same.
11. Vibration of drum of ear of listener at the telephone and a sound heard.

Not only the pitch but the tone of the voice was distinctly heard.

THE COFFEE-LEAF DISEASE

TWO interesting papers on this subject were read at the last meeting (3rd inst.) of the Linnean Society, the one treating of its ravages in India, the other its nature and spread in South America.

In the first Mr. Wm. Bidie, in a letter to Mr. J. Cameron of Bangalore, refers to the Coorg country, situated in the Western Ghats, where European enterprise in coffee has been wholly developed within the last twenty-five years, and no disease was observed till four or five years ago. The author mentions that the disease appears to have been imported from Ceylon by way of Chickmoorloor, a district of Mysore, sixty miles distant from Coorg. It seems worst in impoverished, exposed fields, and least where there is shade and rich soil. A small red insect has been noticed feeding over leaves covered with the pest, but what the insect's relation is to the disease as yet remains undetermined. Plants grown from Ceylon seed suffer most, while those trees of Coorg origin and growth are least affected. A system of "renovation-pitting" has been successfully tried, a pit being dug at short intervals wherein, after judicious pruning, all the affected leaves are buried, and this precaution seems to check the spread of the disease, particularly among the Coorg coffee-trees.

In the second communication Dr. M. C. Cooke describes and summarises all the data extant up to the present time of the progress of coffee disease in South America. Plantations in Venezuela, Costa Rica, Bogota, Caracas, and Jamaica have been affected. He discourses on the nature of the blight, and is of opinion that the disease is a complicated one, being himself as yet unprepared to affirm that either the *Septoria*, the *Sphærella*, or the *Stilbum*, three so called different kinds of fungi, or altogether, is the true cause of the disease. At the same time he thinks it possible that none of these forms of fungus are autonomous, and that all may be related to each other as forms or conditions of the same fungus, of which *Sphærella* is the highest and most perfect manifestation. He observes that the discoloured spots may be without any visible fungus upon them, and exhibit no trace of mycelium in the tissues, or they may nourish a *Septoria*, as seen by the Rev. M. J. Berkeley, or a *Sphærella* as found by himself, or finally a species of *Stilbum* as seen by Prof. Saenx and himself. Further, the *Stilbum* may occur on the same spot as the perithecia of the *Sphærella*, or both perithecia and *Stilbum*, the one without the other may be found occupying different spots. Mr. Cooke admits that altogether it is difficult satisfactorily to answer the question, What is the cause of this form of coffee disease?

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—Sir William Harcourt announced on Monday that the evidence taken before the Oxford University Commissioners would be laid before Parliament without delay.

CAMBRIDGE.—The first Smith prize has been adjudged to A. R. Forsyth, of Trinity College, Senior Wrangler. R. S. Heath, of Trinity College, Second Wrangler, and A. E. Steinthal, also of Trinity College, Third Wrangler, were equal in the competition for the second prize.

Mr. W. J. Lewis, M.A., of Trinity College, Cambridge, and Fellow of Oriel College, Oxford, has been elected to the Chair of Mineralogy, in the place of the late Prof. Miller, F.R.S. The University is to be congratulated on having secured as Professor of Mineralogy one so competent to take Prof. Miller's place.

Mr. A. Scott is giving demonstrations in Elementary Organic Chemistry at the University Laboratory. Mr. J. F. Walker is lecturing on the same subject at Sidney Sussex College.

Lord Rayleigh is giving a short course on the Unit of Electrical Resistance, and on February 21 will commence an advanced course of lectures on Sound. Mr. Glazebrook is giving demonstrations on Advanced Electricity and Magnetism, and

Mr. Shaw on Heat. All these courses are given in the Cavendish Laboratory

Prof. Stuart is lecturing on the Differential Calculus and its Application to Mechanics, the Demonstrator has a course on Elementary Applied Mechanics.

Dr. Michael Foster continues his course of Elementary Physiology The advanced lectures announced this term are by Mr. Lea (who has been appointed Lecturer in Physiology at Gonville and Caius College), on Physiological Chemistry, Mr. Langley, on the Histology and Physiology of the Digestive System, and Mr. Hill (Downing College), on the Central Nervous System

The Report of the Syndicate on the Higher Education of Women is to be discussed to morrow (February 11)

The Board of Natural Science Studies recommends that the agreement between the University and Dr Dohrn, of the Zoological Station at Naples, by which 75*l* per annum is paid from the Worts Travelling Bachelors' Fund towards the expenses of the station, be renewed for five years. The Board calls attention to the services which those members of the University who have studied at Naples have rendered to science and the University, and to the fact that three of them have obtained professorships elsewhere, namely Professors A M Marshall (Owens), T. W Bridge (Mason's College, Birmingham), and A C Haddon (Dublin)

At Newnham College Miss Harland is lecturing on Euclid and Algebra, and Miss Scott on Analytical Conics, Mr. Garnett lectures on Statics and on Experimental Physics, Mr. Hudson on Arithmetic and on the Differential Calculus, Mr Hillhouse on Botany, while Miss Cross superintends practical and paper work in Chemistry and Geology.

SOCIETIES AND ACADEMIES

London

Royal Society, December 9, 1880.—"The Electrostatic Capacity of Glass," by J. Hopkinson, M A, D.Sc., F R.S.

In 1877 I had the honour of presenting to the Royal Society (*Phil Trans.*, 1878, Part 1.) the results of some determinations of specific inductive capacity of glasses, the results being obtained with comparatively low electromotive forces, and with periods of charge and discharge of sensible duration In 1878 Mr. Gordon (*Phil Trans*, 1879, Part 1) presented to the Royal Society results of experiments, some of them upon precisely similar glasses, by a quite different method with much greater electromotive forces, and with very short times of charge and discharge Mr Gordon's results and mine differ to an extent which mere errors of observation cannot account for Thus for double extra dense flint glass I gave 10 1, Mr. Gordon 3 1, and subsequently 3 89 (Report of British Association for 1879). These results indicate one of three things, either my method is radically bad, Mr Gordon's method is bad, or there are some physical facts not yet investigated which would account for the difference Two suggestions occur —1 Possibly for glass K is not a constant, but is a function of the electromotive force 2 When a glass condenser is discharged for any finite time, a part of the residual discharge will be included with the instantaneous discharge, and the greater the time the greater the error so caused To test the first I measured the capacity of thick glass plates with differences of potential ranging from 10 to 500 volts, and also of thin glass flasks between similar limits; the result is that I cannot say that the capacity is either greater or less where the electromotive force is 5000 volts per millimetre than where it is $\frac{1}{2}$ volt per millimetre. The easiest way to test the second hypothesis is to ascertain how nearly a glass flask can be discharged in an exceedingly short time. A flask of light flint glass was tested, it was charged for some seconds, discharged for a time not greater than $\frac{1}{17000}$ second, and the residual charge observed so soon as the electrometer needle came to rest, the result was that the residual charge under these circumstances did not exceed 3 per cent of the original charge, also that it mattered not whether the discharge lasted $\frac{1}{17000}$ second or $\frac{1}{20}$ second. These experiments suffice to show that neither of the above suppositions accounts for the facts

I have repeated my own experiments with the guard ring condenser, but with a more powerful battery, and with a new key which differs from the old one, inasmuch as immediately after the condensers are connected to the electrometer they are separated from it. In no case do I obtain results differing much from those I had previously published

Lastly, a rough model of the five plate induction balance used by Mr Gordon was constructed, but arranged so that the distances of the plates could be varied within wide limits. So far as instrumental means at hand admitted Mr Gordon's method was used A plate of double extra dense flint and a plate of brass were tried In the first, by varying the distances of the five plates, values of K were obtained ranging from $1\frac{1}{3}$ to $8\frac{1}{4}$, with the latter results from $\frac{1}{10}$ to 3 It is clear that the five plate induction balance thus arranged cannot give reliable results

The explanation of the anomaly, then, is that the deviation from uniformity of field in Mr. Gordon's apparatus causes errors greater than any one would suspect without actual trial. It is probable that the supposed change of electrostatic capacity with time may be accounted for in the same way.

January 27.—"Dielectric Capacity of Liquids" By J. Hopkinson, F R S

These experiments have for object the determination of the refractive indices and the specific inductive capacity of certain liquids, and a comparison of the square of the refractive index for long waves and the specific inductive capacity

In the following table are given the results obtained for refractive index for long waves deduced by the formula $\mu = \mu_\infty + \frac{b}{\lambda^2}$, the square of μ_∞, and the observed values (K) of the specific inductive capacity

	μ_∞^2	K
Petroleum spirit (Field's)	1 922	1 92
Petroleum oil (Field's)	2 075	2 07
,, (Common)	2 078	2 10
Ozokerit lubricating oil (Field's)	2 086	2 13
Turpentine (Commercial)	2 128	2·23
Castor oil	2 153	4 78
Sperm oil	2 135	3 02
Olive oil	2 131	3 16
Neatsfoot oil	2 125	3 07

It will be seen that whilst for hydrocarbons $\mu_\infty^2 = K$, for animal and vegetable oils it is not so.

Zoological Society, February 1.—Prof W. H Flower, LL D, F R S., president, in the chair.—Mr F. M. Balfour, F R S, read a paper on the evolution of the placenta and made some observations on the possibility of employing the characters of this organ in the classification of the mammals —Mr Sclater read notes on some birds collected by Mr E F im Thurn in British Guiana, amongst which was an example of a new species of *Agelæus*, proposed to be called *A im-Thurni*, after its discoverer —Mr W T. Blanford, F R S, read an account of a collection of reptiles and frogs made at Singapore by Dr W B Dennys In this collection were two new species of Ophidians, which were named respectively *Cylindrophis lineatus* and *Simotes Dennysi*, and two new frogs, which the author proposed to call *Rana laticeps* and *Rhacophorus Dennysi* —Mr A. D. Bartlett read an account of a peculiar habit of the Darter (*Plotus anhinga*) in casting up parts of the epithelial lining of its stomach, as observed by him in the specimen now living in the Society's collection —A communication was read from Mr A Heneage Cocks, F Z S, containing notes on the breeding of otters, as observed by him in specimens living in his possession.—The Secretary read a paper by the late Mr Arthur O'Shaughnessy, containing an account of a large collection of lizards made by Mr C. Buckley in Ecuador The collection was stated to be of great interest, both on account of the number of new species it contained and the fresh material it afforded for the study of species already known. Mr O'Shaughnessy had given last year a partial notice of this collection, confined however to a preliminary list of the species of *Anolis* identified The present paper gave the results of a study of the whole collection, and was not restricted to a description of the new forms, but enumerated all the species, for the purpose of recording additional remarks and revisions which appeared necessary In it twenty seven species were mentioned, ten of which were new —Mr G A Boulenger read an account of a new species of *Enyalius* in the Brussels Museum, from Ecuador, which he proposed to name *Enyalius O'Shaughnessyi* —Lieut -Col H H Godwin-Austen, F R S, read the first part of a memoir on the land-shells collected on the island of Socotra by Prof I B Balfour The present communication comprised an account of the species of *Cyclostomaceæ* found on the island

Photographic Society, January 11 —J Glaisher, F R S, president, in the chair —Papers were read by E Viles on the

lime light. The principal matter insisted upon was that the oxygen and hydrogen gases should unite in one stream, just before issuing from the nozzle of the burner, and the tubes kept entirely free from wire gauze or any impediment whatever; also that the lime cylinder should be in two pieces, when if the upper part splits the lower part (already heated) could be screwed into position at once.—Also by T. Bolas, F.C.S., on the detective camera. This apparatus consists of two cameras working simultaneously together: in one the image can be seen, whilst in the other a sensitive dry plate is ready for instant exposure by pneumatic power. The whole is inclosed in an unsuspicious wooden box, which can even be placed upon the ground, and scenes and persons photographed unawares.

Victoria (Philosophical) Institute, February 7.—The Earl of Shaftesbury, K.G., in the chair.—A paper was read by Dr. Samuel Kinns, F.R.A.S., on "The Truths of Revelation confirmed by the Advances of Science."

Institution of Civil Engineers, February 1.—Mr. Abernethy, F.R.S.E., president, in the chair.—The paper read was on the Portsmouth Dockyard Extension Works, by Mr. Charles Colson, Assoc. M. Inst. C.E.

PARIS

Academy of Sciences, January 31.—M. Wurtz in the chair.—The following papers were read:—On the long duration of the life of germs of *charbon*, and on their preservation in cultivated earth, by M. Pasteur, with MM. Chamberland and Roux. This relates to an inquiry made by a committee elected by the Paris Society of Veterinary Medicine. Sheep caught the disease from being a few hours daily on ground where animals that died of *charbon* had been buried twelve years before. There was no grass to eat; the germs must have entered the sheep by reason of their habit of smelling about the ground. The farmer had a scar of malignant pustula.—Observations on the birds of the Antarctic Region, by M. Alph. Milne-Edwards. This relates to the first part of a work on the fauna of Austral regions. Birds serve more than any other animals to mark the profound differences between faunas of the southern and those of the northern hemisphere. The geographical distribution of penguins and spheniscans present interesting features in this respect.—On a mode of representation of functions, by M. Gyldén.—On a fall of sleet at Geneva, on January 19, by M. Colladon. The grains were compact and pretty round, and they showed curious dancing movements (sometimes after being motionless two or three seconds), like those of pith balls under electricity.—M. Clos was elected Correspondent in Botany, in room of the late M. Godron.—On the circulatory apparatus of edriophthalmate crustaceans (continued), by M. Delage. This relates to Amphipoda and Læmodipoda.—Action of sulphocarbonate of potassium on phylloxerised vines, by M. Mouillefert. The effects of three to six, two, and one year's treatment are severally considered.—On the figure of planets, by M. Hennessy. For the earth and near planets supposed like it the compression deduced from the theory of fluidity agrees better with observation than that deduced from the theory of superficial erosion.—On the series of Fourier, by M. Jordan.—On an extension of the rule of signs of Descartes, by M. Laguerre.—On a particular cyclic system, by M. Ribaucour.—On the quadrature on which depends the solution of an extensive class of linear differential equations with rational coefficients, by M. Dillner.—On the distinction of integrals of linear differential equations into sub-groups, by M. Casorati.—On the invariant of the eighteenth order of binary forms of the fifth degree, by M. Le Paige.—Action of hydrochloric acid on metallic chlorides (continued), by M. Ditte. In the case of chlorides very soluble in water (less so in acid liquor), and deposited in it as crystallised hydrates, hydrochloric acid diminishes the weight of chloride dissolved, and in the acid liquors one still finds hydrated salts, though much less rich than the crystals that form in this liquid. Another (and last) group contains chlorides that crystallise anhydrous in water or hydrochloric acid, but the solubility of which in concentrated acid is reduced almost to zero.—Determination of the colours which correspond to fundamental sensations, by means of rotatory disks, by M. Rosenstiehl. The line which represents the proportion of extreme sensations in the intermediate colours is a straight one (they are thus, to sight, rigorously equidistant). The line which represents the sensation of yellow reaches its culminating point in the ordinate corresponding to yellow. The sensation of red rises in a straight line to the red, and beyond that to the orange, where it culminates; then it falls to the yellow, where it is zero.—On the determination of carbonic acid in air, by MM. Muntz and Aubin. They have studied the variations of which the proportion of CO_2 in special parts of the atmosphere is susceptible, and here first describe their method (absorption by pumice-stone impregnated with potash solution, then liberation, and measurement of volume), and verify its value.—Observations on a note by M. Eisenberg, on separation of trimethylamine from substances accompanying it in commercial chlorhydrate of trimethylamine, by MM. Duvillier and Buisine.—On a process of total destruction of organic matters, for investigation of poisonous mineral substances, by M. Pouchet. The principle is that it is possible to heat between 300° and 400°, in presence of carbon or organic compounds, mineral elements contained in a mixture of sulphuric acid and acid sulphate of potash. The sulphate of potash retains substances the most volatile and decomposable (*e.g.* salts of mercury), while the organic matters are quickly destroyed.—On the invasion of pulmonary tissue by a champignon, in peripneumonia, by M. Poincaré.—The third edition of M. Domeyko's Treatise on Mineralogy (in Spanish) was presented. It contains original researches on various South American minerals.

VIENNA

Imperial Academy of Sciences, February 4.—V. Burg in the chair.—F. Osnaghi and V. Lorenz, fifth report of the Adria Commission on the Physical Exploration of Adria.—Prof. L. Pelz, on scientific treatment of axonometry.—Prof. A. Wassmuth, on the possibility of magnetising iron at high temperatures.—Prof. T. Hann, on the daily course of some meteorological elements in Vienna (city).—G. Bruder, on the knowledge of the Jura-formation of Sternberg near Zeidler (Bohemia).—Prof. Sigmund Exner, on the knowledge of the minute structure of the cortex of the brain.

GÖTTINGEN

Royal Society of Sciences, August 7, 1880.—On fluospar in granite of Drammen, by O. Lang.—Some experiments on induction in conducting bodies, by F. Himstedt.

November 5.—On an increase of the meteorite collection of the University, by C. Klein.—Communication regarding the publication of a text book of analysis, by R. Lipschitz.—Electrical shadows, by W. Holtz.

December 6.—Electrical shadows (continued), by W. Holtz.—On the connection between the general and the particular integrals of differential equations, by L. Königsberger.—Observations in the magnetic observatory, by K. Schering.—On congenital growth in the thallus of Pollexfeniea, by P. Falkenberg.—Communications on the University Library from 1876-79, by W. Willmanns.

CONTENTS

THURSDAY, FEBRUARY 17, 1881

ISLAND LIFE

Island Life, or, The Phenomena and Causes of Insular Faunas and Floras, including a Revision and Attempted Solution of the Problem of Geological Climates By Alfred Russel Wallace. (London Macmillan and Co., 1880.)

I.

MR. WALLACE is to be congratulated on his success in that most difficult part of book-writing—the choice of a good descriptive, yet short and euphonious, title "Island Life!" What do not the words suggest! How many old associations do they not recall! A vacant and unsuspicious reader may indeed be lured by them to open what he may expect will prove a good novel, perhaps a story of the "Robinson-Crusoe" type. His hopes will be quenched by the first chapter, but if he possesses any capacity for an interest in the flowers, insects, birds, and beasts of his home, it will almost certainly be quickened by a perusal of that chapter. Like a skilful composer Mr. Wallace strikes at once with a firm touch the key-note of his volume In a few pages he puts before us the problem he seeks to solve, and does this in so graphic and masterly a way that most readers will not only comprehend what he aims at, but will be persuaded into the belief that as they are familiar with some parts of the subject they have a personal interest in seeing what the author can make of it.

Hardly any problem in modern science is at once so complex and so fascinating as the geographical distribution of plants and animals. Strange to say, this complexity and fascination have steadily increased with the growth of knowledge A generation ago, the grouping of floras and faunas found a ready explanation in differences of climate and special creations But no such easy solution of the difficulties now avails Ever since the classic essay of Edward Forbes on the history of the British flora there has been a growing conviction that the present arrangement of the life of the globe is the outcome of previous geological and biological changes. The doctrine of evolution has given to this conviction the strength of demonstrated truth. But while the theoretical aspect of the question may be clear enough, we are beset on all sides by what seem utterly insuperable obstacles when we try to work out the application of this theory to the history of any given flora or fauna. This is true even in those areas of Europe and North America where the living plants and animals are most fully known, and where some approach to a complete unravelling of the geological record has been made. But over most of the rest of the globe our knowledge of botanical and zoological distribution, and still more of geological history, is of the scantiest and most fragmentary kind. A few broad facts in the history of the mammalian life of the northern hemisphere are well established The pedigree of some modern forms, such as the horse, can be traced back into early Tertiary times, the former wide spread of other forms, the lion for instance, and their gradual restriction in area, have been satisfactorily made out. But the kind of evidence available in these cases fails us in dealing with others It seems as if all that we may hope to achieve is to establish by a few examples, capable of clear proof, the general laws by which variation in form and in geographical distribution appears to have been effected among the animal and vegetable populations of the globe.

By no living naturalist could these problems be more fittingly and exhaustively discussed than by the author of "The Malay Archipelago" Years of research in the East, followed by years of research and reflection at home, have enabled him to explore every highway and a vast number of byways in the wide realm of inquiry in which he has been so active and untiring a worker Thoroughly conversant with all that has been done by others, he brings to his task a wealth of information and a breadth of view that stamp his works with the authority of a master

The present volume may be regarded as an expansion of a part of the author's "Geographical Distribution of Animals" Further study of the problem of distribution has enabled him to treat it with greater fulness He has devoted especial attention to geological operations that have affected the successive races of plants and animals, and has connected these operations with biological changes more closely and clearly than has hitherto been done Of his new volume the first half is mainly occupied with a discussion of this subject He there seeks to establish a number of fundamental propositions or laws, the confirmation of which leads in his opinion to a simpler and fuller solution of the problem than has before been possible Two of these doctrines deserve the careful consideration of geologists and naturalists They are (1) the permanence of continental and oceanic areas, and (2) the frequency of changes of climate during geological time and the combined influence of cosmical and geographical causes in the production of these changes.

The abundance of marine organisms in the rock-masses which constitute the bulk of the continents naturally led to a belief in the mutability of the land Not once only but many times in succession the sites of some of our loftiest mountains were under the sea And if it was discovered that the position of the land had been so variable, and that the sea-floor had been so continually upraised, the inference was easily drawn that land and sea must have been continually changing places. Tacitly or explicitly it was assumed that just as there appeared to be no area, even in the heart of the continents, which had not been submerged beneath the waves, so there was probably no tract even of mid-ocean where a continent might not have bloomed It is probably a safe assertion to say that this is still the belief of most geologists It finds formal expression in their most authoritative text-books, and can be traced everywhere in its influence upon the discussion of questions of geological history From geological treatises it has passed out into the current literature of the time, as one of the accepted conclusions of science. Our Poet Laureate, who has embodied in musical language not a little of the scientific speculation of his day, has given terse expression to this universal belief in the often-quoted lines —

> "There rolls the deep where grew the tree
> O earth, what changes hast thou seen!
> There, where the long street roars, hath been
> The stillness of the central sea."

R

Inevitable as was this belief in the early days of geology, and firmly as it still maintains its hold, it is unquestionably based upon a partial view and erroneous interpretation of the facts This has for some years been recognised by a few writers, and will before long be generally acknowledged. Instead of shifting their places on the earth's surface, continents, so far as the evidence of their history can be gleaned, have been wonderfully persistent.

This conclusion is reached by many different paths of inquiry Of these it may suffice to notice here only two (1) The rocks of which the greater part of the dry land consists, are upraised marine sediments But their materials were derived from the waste of neighbouring dry land They everywhere contain indications of the proximity of that land, and even reveal terrestrial surfaces, such as rippled-marked and rain-pitted shores, in the very midst of marine formations Nowhere do they present indications of really deep water (2) An examination of the floor of the present ocean proves that the sediment now removed from the surface of the continent is deposited in the shallower waters within 150 or 200 miles from land Beyond this limit terrestrial sediment ceases to be transported and deposited, its place being taken by organic accumulations and by peculiar red and grey "clays" in which the inorganic material is mainly of volcanic origin, and must gather on the bottom with almost inconceivable slowness This grouping of the detritus, derived from the degradation of the land, is evidently the only one possible, and it has now been abundantly demonstrated by recent deep-sea researches We may be sure also that it must always have obtained in every geological period The coarser and more lenticular sheets of sediment have accumulated nearest to the sources of supply, that is to the shores of the land, while the finer and more wide-spread silts have been spread over the farther and deeper tracts of that still comparatively narrow belt of sea to which sedimentation has always been mainly confined To hasty readers it will seem an obvious and ridiculous paradox to maintain that the continents have been permanent throughout geological time, and yet to admit that probably no part of their surface has not been many times submerged beneath the ocean Further reflection, however, and better acquaintance with the facts will convince every candid inquirer that the paradox is only in appearance The continental ridges have been the great lines of terrestrial movement from the dawn of geological history. They have continually been undergoing disturbance; one portion has been equably upraised, another has been convulsed and corrugated, a third has been depressed Every part of their surface has been subject to these changes Moreover every portion of the crust which has risen above the sea-level has been exposed to the unremitting attacks of the subaërial agents of destruction. Again and again the solid bulk of the continents has been reduced to mere detritus and has been spread over the sea-bottom. And yet the continental ridges have never ceased to exist Their disappearance would necessarily have been followed by the cessation of sedimentary accumulation. The character of their component rocks however teaches that, whether by the operation of underground movements or by the action of superficial causes, the land has been continually wandering, as it were, to and fro across the continental areas, disappearing beneath the sea in one region, reappearing from the sea in another. In one sense of course it may be said that land and sea have been continually changing places. But the submerged land has not become truly a part of the oceanic realm The waters covering it have been mere prolongations of the upper layers of the ocean, like the Mediterranean, Black, and Caspian Seas of the present day An elevation or depression of a few hundred feet, sufficed to turn wide tracts into land or into water But such oscillations made no real change in the essential position of the grand aboriginal oceanic basins and continental ridges

Mr Wallace has thoroughly grasped the truth and significance of these averments, and has not been slow to perceive their fundamental importance in the history of terrestrial floras and faunas. He finds that they furnish new and unexpected assistance to the student of biological evolution, and indeed form a necessary part of the doctrine "It is impossible," he says, "to exaggerate or even adequately to conceive the effect of these endless [terrestrial] mutations on the animal world. Slowly but surely the whole population of living things must have been driven backward and forward from east to west or from north to south, from one side of a continent or a hemisphere to the other. Owing to the remarkable continuity of all the land masses, animals and plants must have often been compelled to migrate into other continents, where in the struggle for existence under new conditions many would succumb; while such as were able to survive would constitute those widespread groups whose distribution often puzzles us. Owing to the repeated isolation of portions of continents for long periods, special forms of life would have time to be developed, which when again brought into competition with the fauna from which they had been separated, would cause fresh struggles of ever-increasing complexity, and thus lead to the development and preservation of every weapon, every habit, and every instinct which could in any way conduce to the safety and preservation of the several species"

Besides interchanges of sea and land Mr. Wallace lays great stress upon former vicissitudes of climate as agents in the modification of plant and animal life He has discussed this subject with great detail and offers an original explanation of the causes of secular changes of climate. Adopting generally Dr Croll's views as to the relation between the Glacial period and the excentricity of the earth's orbit, he introduces into them certain modifications and limitations. If, he argues, the effects of a high excentricity have always been shown in great Polar refrigeration and a general lowering of the temperature in the hemisphere whose winter occurred in *aphelion*, there ought to be geological evidence of the change. He confesses however that although indications of local ice-action have been noticed in different geological formations, even as far back as old Palæozoic deposits, there is certainly no trace of such general glaciations as the theory would lead us to expect. Not only so, but the testimony of organic remains is everywhere and unmistakably against the theory. He concludes, therefore, that while the astronomical influences must unquestion-

ably be a *vera causa* in the production of terrestrial climate, and must always *tend* to produce alternate mild and severe conditions, there must be some counteracting cause whereby these influences are weakened or neutralised. This modifying effect he assigns to changes in the distribution of land and sea, especially in high latitudes. He contends that without lofty land there can be no permanent snow and ice. Consequently by the due elevation of Arctic land an area would be provided on which, when winter occurred in *aphelion* during a period of high excentricity, there would be so copious an accumulation of snow and ice, that even during *perihelion* the wintry conditions would continue, and perhaps even in an intensified form. Subsidence of this land, however, would admit the warm oceanic currents from lower latitudes, and so great would be the amount of heat thereby transferred that even winter occurring when the North Pole was turned from the sun and the earth's orbit was at a maximum of excentricity would be insufficient to cover the Polar regions with an ice-cap. The alternate phases of precession, which tend to bring warmer and colder conditions of climate every 10,500 years, would introduce a complete climatal change only where the land was partially snow-clad. The general conclusion is thus reached that, the climates of the globe being mainly dependent on geographical conditions, their mutations in former periods have been chiefly brought about by changes in physical geography. Mr Wallace supports these views by much ingenious reasoning. He argues that during by far the greater part of geological time the distribution of land has been such that warm oceanic currents have been able to pass freely to the North Pole, giving a mild climate to the whole northern hemisphere. He would thus account for the palæontological evidence of long-continued glacial conditions within the Arctic circle from Palæozoic to late Tertiary times. It was only in very recent times, he thinks, that the great northern continents became so completely consolidated as to shut out the tropical currents and to render possible the wide-spread and intense glaciation which was actually brought about by the high excentricity that occurred about 200,000 years ago. According to this view geographical revolutions "have been the chief, if not the exclusive, causes of the long-continued mild climates of the Arctic regions, while the concurrence of astronomical influences has been essential to the production of glacial epochs in the temperate zones, as well as of local glaciations in low latitudes."

In a remarkable chapter, remarkable as the deliberate judgment of an accomplished naturalist, the author decides that the vast periods of time which used to be demanded for the changes of geological history are not required even for the evolution of the floras and faunas of the earth. He admits, with some geologists who have advanced the same view from physical data, that geological changes probably occurred more vigorously and rapidly in former times than they do at present, and as these changes have always been accompanied by relative alterations in the forms of the organic world, he believes that organic evolution has taken place far more rapidly than has been hitherto thought possible.

ARCH. GEIKIE

ALGÆ

Species, Genera, et Ordines Algarum, seu descriptiones succinctæ specierum, generum, et ordinum, quibus Algarum regnum constituitur, auctore Jacobo Georgio Agardh, Bot. in Acad. Lund. Prof. Emer. Vol. iii. pars ii. 8vo. pp. 301. (Lipsiæ: apud T. O. Weigel, 1880.)

THE appearance of Dr. J. G. Agardh's excellent work, "Florideernes Morphologi," published in the *Acta* of the Royal Scientific Academy of Stockholm, was duly noticed in the pages of NATURE (vol. xxi. p. 282), but, as the work was written in Swedish, a knowledge of its contents was accessible to a limited number of students only; the indefatigable author has therefore, with a view to render it more useful to those who take an interest in his subject, now issued an edition in Latin of the Morphology.

This new volume, which is in 8vo, forms the second part of the third volume of Dr. Agardh's "Species, Genera, et Ordines Algarum," and may be considered rather as a revised edition of the Swedish work than as an exact translation of it. The author has made some alterations both in the text and in the notes. These alterations include important remarks on the most recent algological publications, including M. Bornet's "Notes Algologiques," M. Sirodot's observations on the fecundation of the Batrachospermeæ, and those of M. Dodel-Port on the fertilisation of the spores of Algæ by Vorticellæ.

For a summary of the contents of the new work the reader is referred to the before-mentioned notice in NATURE; it may however be remarked that the present volume forms a valuable addition to the "Species, Genera, et Ordines Algarum," to which it is now appended, and its appearance will undoubtedly be welcomed by all who take an interest in the morphology of Algæ.

In addition to a table of contents and an *index rerum*, there is also an index of the species referred to. The latter is the more useful, because, in addition to the name of the species, there are special references to the descriptions of the structure, ramification, reproductive organs, and other particulars relating to the plants. This arrangement is especially convenient, inasmuch as these matters are treated separately in different parts of the work.

It is to be regretted that the beautiful illustrations appended to the Swedish edition do not accompany the present. The figures are referred to in the latter, and may be consulted by those who are fortunate enough to possess a copy of the former, or who have access to libraries which contain copies of the *Acta* of the before-mentioned Swedish Academy. It may be added that Dr. Agardh's descriptions of the parts of the plants are expressed with his usual precision and clearness, and can, therefore, be understood without the plates—though, undoubtedly, better with them.

It may be observed that the present volume treats solely of the morphology of the Florideæ, and the author does not allude to the classification of Algæ, except to express his opinion that certain Algæ of red or purple colours, such as Bangiæ and Porphyræ, included by many algologists among the Florideæ, do not really belong to that class (p. 9, *note*). MM. Thuret and Le Jolis excluded these plants from the old class of chlorosperms, to which they were formerly considered to belong,

Dr. Agardh does not admit them among the Florideæ; and in Dr. A. W. Bennett's new scheme for the classification of the lower cryptogams,[1] they seem to be literally nowhere. Neither has Dr. Bennett assigned any place in his scheme to the rather extensive family Valonieæ. It is to be hoped that algologists will agree before long on the position which these forms are finally to occupy in the classification of Algæ.

His work on the Florideæ having been thus brought to a successful termination, it is to be hoped that Dr. Agardh will now turn his attention to the Melanosperms, and that he will, before long, give us a new edition of the first volume of his "Species Algarum", a work rendered necessary by an increased knowledge of the structure and fructification of these plants, and by the discovery and accurate examination of many new species. The ex-professor has already revised and reconstructed the extensive genera *Laminaria*, *Zonaria*, *Fucus*, *Cystophora*, and *Sargassum*—the latter as far as relates to the Australian species of the sections *Pterocaulon* and *Arthrophycus* only. To these must be added descriptions of many new species of Melanosperms, all of which have been published in the *Proceedings* of the Swedish Academies, and are, therefore, not within reach of many who would gladly consult them. A new edition, in which these scattered papers shall be collected and classified, would be a boon to algologists, and, we trust, would not entail very great labour upon the learned and industrious author.

M. P. M.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.

The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

"The New Cure for Smoke"

NATURE, vol. xxiii. p. 25, contains a letter from Dr. Siemens on a "new cure for smoke," and in that letter it is stated that, instead of using inert matter such as pumice-stone, he (Dr. Siemens) considers it far more economical and efficacious, in a gas-grate to transfer the heat of the gas flames to gas-coke or anthracite, and that the result obtained shows that the "coke-gas fire" is not only warmer, but cheaper than its predecessor, the coal-fire, with the advantage in its favour that it is thoroughly smokeless.

Now having had considerable experience with gas-heating fires of various kinds, and being much interested in the success thereof, I determined to give the "gas-coke grate" a practical trial, and as the result of the trials which I have just completed, and which extended over a period of two months, may interest many of your readers, possibly you may be able to find space in your columns to record the following particulars:—

In the first set of trials a good modern fire-grate was arranged (as described by Dr. Siemens) with a solid iron dead-plate, and ½-inch gas-pipe, pierced with holes $\frac{1}{20}$th of an inch in diameter, placed in the front part of the grate, but behind the lowest bar, and all air excluded from below except that which was allowed to pass in between the hollow bottom and enter on the line of gas flames. The grate was then filled with coke broken into pieces about the size of a large walnut, the gas turned on and lighted. In a short time a good bright fire with a rich flame was obtained, the external temperature at starting was 32° F., and that of the room 45° F. This latter rose within two hours to 62° F., and was maintained as long as the fuel lasted, viz. fifteen hours, the gas and coke burning brightly the whole time.

The result of a number of these trials, with an expenditure of 28 lbs. of coke, was an average consumption of 325 cubic feet of gas, the expenditure of the latter being very accurately ascertained by passing the gas through a standard test meter.

A second set of trials was then made under conditions precisely similar to the above, with the exception that the gas was used only for lighting the coke at the commencement, and when a good fire was obtained, and the temperature had risen to 62° F., it was turned off, and only used again for a short time to reinvigorate the fire and maintain the temperature. This second series of trials—with an expenditure of 28 lbs. of coke—resulted in an average consumption of fifty cubic feet of gas, the fire, when the gas was turned off, was not so bright or rich as in the first series, and the fuel only lasted thirteen hours.

Upon the completion of the coke and gas trials as above, the grate was restored to its original condition for burning coal. The fire was lighted in the usual manner, and within two hours the temperature rose to 62° F. as in the previous trials, the external temperature at starting being 32° F., and that of the room 45° F., and with a consumption of 28 lbs. of coal 62° F. was maintained for fourteen hours.

The room in which the experiments were made was the same in each case, having a capacity of about 3000 cubic feet, a due north aspect, and situated about 150 yards from the river, to which it is entirely open.

The above facts having been ascertained after an extended and repeated series of trials, in which the fuel was most carefully weighed and the gas measured, it now becomes a simple matter to reduce the results to £ s. d., and in doing so I have taken the present prices of gas, coke, and coal in this neighbourhood, which are as follows:—Coal, 26s. per ton; coke, 12s. per chaldron; and gas, 3s. 3d. per thousand cubic feet. From these we obtain the undermentioned results, viz.:—

First Trials. Coke and Gas continuously for fifteen hours.

	d.
28 lbs. of coke at 12s. per chaldron	2·571
325 cubic feet of gas at 3s. 3d. per 1000 cubic feet	12·675
	15·246

Or 1·0164 pence per hour.

Second Trials. Coke, with Gas for lighting and use occasionally for assisting the Coke, for thirteen hours.

	d.
28 lbs. of coke at 12s. per chaldron	2·571
50 cubic feet of gas at 3s. 3d. per 1000 cubic feet	1·950
	4·521

Or ·3477 of a penny per hour.

Third Trial. Coal only, for fourteen hours.

	d.
28 lbs. of coal at 26s. per ton	3·9

Or ·2785 of a penny per hour.

It will, I think, be at once seen from the foregoing results that although by the use of gas and coke we get rid of the smoke nuisance, that desirable end is not obtained entirely without cost, and that, judging from these experiments, the "coke gas fire," while possessing many of the advantages claimed for it, has not proved in this instance to be warmer and cheaper than its predecessor the "coal fire."

Possibly some of your professional readers may find time to pursue the subject further and favour us with the result of their investigations. I have given a good deal of attention for years past to the employment of gaseous fuels, and have made many experiments, but I do not at the present time know of any fire-grate or stove (for ordinary household purposes) wherein gas is employed as the heating agent, either wholly or in part, which gives such good results as the raw material coal. At the same time there can be little doubt but that we shall yet discover the way to effect great economy in the use of fuel both for domestic and manufacturing purposes, and ultimately to solve the smoke nuisance question; but whether it will be by separating the raw material into its several constituents and bringing some of them together again under different conditions and proportions when being consumed in a gas furnace or grate, or by better and more perfect appliances for effectually burning the fuel in its raw state, has, I think, yet to be settled. The question however is one which concerns all alike, being a matter of both personal and national interest.

J. A. C. HAY

Royal Arsenal, Woolwich, January 29

[1] See the Report in NATURE (vol. xxii. p. 451) of a paper read before the British Association at Swansea last year.

I HAVE been much interested in reading the above, and I hope that Mr Hay's example will be followed by other observers, in order to establish a fair average result of the relative cost of the coke-gas grate and the ordinary coal grate Mr. Hay's results are not as favourable as those obtained by myself, owing probably to some imperfection in his arrangements, which are not described sufficiently to form any judgment upon them. I should like to know, for instance, whether the copper back plate, which I presume he used, although it is not referred to, was backed by fireclay, or whether it touched the ironwork of the fireplace, whereby its heat would be conducted away This alone might account for the difference in result obtained by Mr. Hay and myself, and I think this opportunity is a favourable one to send you the figures resulting from my own observation of the original grate described in my article in NATURE, vol xxiii p 25 This grate has now been in use from November 8 to January 31, during which period it has been alight sixty-six days, and the average time during which a bright fire has been kept up has been eight hours daily. During this period of 528 hours there has been consumed—

	£	s	d
1112 lbs coke at 18s a ton	0	9	0
581 lbs smokeless coal at 20s a ton	0	5	2
4100 cubic feet of gas at 3s 6*d* per 1000	0	14	4
	1	8	6

Or an average of 0·518*d* per hour, instead of 0 525*d*, as resulting from my first observation The average consumption of solid fuel per hour has been 3 2 lbs, and of gas 7 7 cubic feet The full supply of gas has generally been allowed during the first hour of lighting, after which it is turned down to about a third, this I find to be a convenient mode of working

In comparing my results with Mr Hay's, it must be borne in mind that my room has a capacity of 7200 cubic feet, with northern aspect, and his a capacity of 3000 cubic feet, also with northern aspect, his consumption should therefore be only $\frac{3000}{7200} \times 0{\cdot}518 = 0{\cdot}216d$ (instead of 0 347*d*), which figure would prove an economy in the employment of the coke gas grate over the coal grate, which is 0 2785*d*. by his own showing, and would agree with the comparative results contained in my original communication. C W SIEMENS

February 2

On the Spectrum of Carbon

IT is very desirable that, if possible, some definite conclusion should be arrived at concerning the chemical origin of the bands, which Prof Liveing calls "hydrocarbon bands," and the importance of the point at issue must be my excuse for again addressing you on this subject.

In my previous communications I pointed out that if it can be shown experimentally that the electric spark, in an atmosphere of cyanogen *free from hydrogen*, gives the groups in question (the groups δ and γ, wave-lengths 5165 to 5082 and 5635 to 5478 respectively, are here the only ones considered), they must be due to carbon, and remarked that the hypothesis that they were due to traces of hydrogen present as impurity is "to adopt an extreme hypothesis which must be supported by cogent experimental evidence before it can be accepted" Prof. Liveing admits the justice of this demand, and then goes on to say that such "cogent experimental evidence, so far as the relations of carbon and *nitrogen* are concerned, will be found in our complete papers on the spectrum of carbon compounds in the *Proceedings* of the Royal Society." This appears to me to be equivalent to an admission that—as concerns carbon and *hydrogen*—no such experimental evidence has yet been given, which is also the conclusion to which I came after perusal of the papers of Profs Liveing and Dewar referred to.

It would seem then that the burden of proof that cyanogen exists in which the spark will not give rise to the bands δ and γ rests with Prof Liveing Nevertheless I have repeated the experiment with cyanogen, described in this journal (vol xxiii p. 197), so as to set aside the objections raised by Prof Liveing to the former experiment. The apparatus was in this case constructed of one piece of glass—a long piece of hard glass tubing. This was carefully cleaned, the tube was then contracted at two points, so as to separate a short portion of the tube, into which platinum wires were fused, so as to form a discharge tube The whole tube was next heated to redness in a furnace, while a current of oxygen passed through it for some considerable time. The greater portion of the tube on each side of the part containing the wires was then filled with phosphoric anhydride, and a short length of the tube, separated from the discharge tube by as great a length of phosphoric anhydride as the length of the tube permitted, was employed as a retort, and filled with mercuric cyanide, the other end of the tube was drawn out and dipped beneath sulphuric acid The mercuric cyanide employed, after being finely powdered, was dried for a long time in an air-bath, then transferred to a clean hard glass tube, in which it was repeatedly heated, while a current of air dried by passing over calcium chloride and phosphoric anhydride was drawn over it From this tube it was transferred immediately to the retort-tube In making the experiment the mercuric cyanide was heated so as to give as low a current of cyanogen as possible, which was continued long enough to expel all the air from the tube The tube was then sealed up, leaving the discharge tube, with a phosphoric anhydride tube on each side of it, and put aside for a week The spectrum was then examined, with the same result as before The tube gave a brilliant carbon spectrum, of which γ and δ (the positions of which were measured) were the brightest groups No trace of the hydrogen C-line was obtained Prof. Liveing objects that this is not a sufficient proof that hydrogen is absent (in which I cannot agree with him), and suggests that "a real test would be to see whether, when the spark gives the line-spectrum of carbon, the hydrogen-lines do not also appear." This test is however not applicable, since (according to my experience) cyanogen cannot be made to give the line spectrum of carbon Further, in this particular case the spark could not be got through the tube when the condenser was put on

Giggleswick, February 11 W M WATTS

"Prehistoric Europe"

As there was no space to allow of all the authorities being cited in my criticism of the above work I now give those which relate to the facts called in question by Dr. James Geikie in NATURE, vol xxiii p 336

1 Dr James Geikie repudiates as absurd the view attributed to him, that the palæolithic gravels "which overlie the chalky boulder clay of East Anglia were covered by an upper and younger boulder clay," and denies that he ever wrote anything which would justify that opinion In "The Great Ice Age," 2nd edition, p 531, he writes "The palæolithic beds dovetail into the glacial drifts, and are overlapped (as in Yorkshire) by the deposits thrown down during the final cold period To the last interglacial period then we must refer the great bulk of the palæolithic river gravels of the south-east of England" If this be true, where are the glacial deposits in question to be seen? If they ever were above, or "overlapped," the palæolithic gravels, they have, so far as our present knowledge goes, been utterly destroyed Of course this view *is* absurd.

2. The reindeer associated with the hippopotamus and hyæna in the same stratum in the Victoria Cave was discovered while the exploration was under my management, and was published in Brit Assoc Rep 1872, *Trans* p 179, and again in Mr Tiddeman's Report, *op cit* 1876, *Reports*, p 118 The animal is omitted by the author where its presence would destroy his argument as to climate, but he does not forget to record its subsequent discovery at a higher level, where it falls in with his argument It may be remarked that the association of reindeer with hippopotamus in this cave has no special theoretical value, because the two animals have been found together in several other hyæna dens

3 The fossil mammalia of Mont Perrier are typical Upper Pleiocene, as may be seen from the works of Croizet and Jobert, Gaudry and Gervais, and as I can testify from their examination The glacial origin of the overlying tuffs, which I have examined under the guidance of M. Julien, seems to me to be open to considerable doubt

4. The mammalia of Leffe, and those of the Val d'Arno with which they are classified by Dr James Geikie, characterise the Upper Pleiocenes of Italy, as may be seen from the careful essays published by Dr. Forsyth Major, and from an examination of the magnificent collection in the museum of the University of Florence.

5 If pages 309-318 of "Prehistoric Europe," dealing with "interglacial epochs," do not imply a belief that the Neolithic skull of Olmo is interglacial, I am unable to ascertain their meaning

The questions whether a geological period is to be classified as hitherto it always has been classified, by an appeal to zoology or by an appeal to ice, and whether the naturalists who have devoted themselves to the study of mammalia have only "opinions," while Dr. James Geikie enjoys "the facts," may be left in silence to the judgment of geologists. In the review under discussion all reference to my own opinion and works has been carefully omitted. Here, so far as I am concerned, the discussion ends. W. BOYD DAWKINS

Owens College, February 11

Geological Climates

IN NATURE, vol xxiii. p 241, Dr. Haughton repeats his former statement that "it is impossible to suggest any rearrangement of land and water which shall sensibly depress the temperature of the east of North America." Now we must only look about us to see that the east of Asia is colder than the east of North America, parallel for parallel, and this especially in winter. The *mean temperature of January* is as follows in places situated as far as possible under the same latitude and at the same distance from the sea.—

Lat N	Eastern Asia		Eastern North America		Difference
56½	Ajan	− 4·2	Nain, Labrador	− 3·8	0·4
53	Nikolayewsk, Amoor	− 12·1	Rigolet Labrador	− 1·1	11·0
43¾	St Olga Bay	12·9	Portland, Maine	21·2	9·3
43¼	Wladivostok	6·1	Portsmouth N H	25·0	18·9
40¾	Newchwang	10·4	Paterson, N J	26·6	16·2
40	Pekin	23·7	Philadelphia	31·3	7·6
31¼	Shanghai	38·3	Mean of Savannah and Ft Marion	53·6	15·3
22¼	Victoria, Hong Kong	59·5	Habana, Cuba [1]	71·4	11·9

This shows that (1) from lat 20° to 55°, Eastern Asia is everywhere from 7½° to 19° F. colder in January than Eastern North America; and that (2) those parts of the coast of Eastern Asia which are not separated by mountains from the interior lowlands are much colder than those which are sheltered, but even the latter parts, though relatively warmer, are yet much colder than the same latitudes in Eastern North America These differences are explained by geographical position Asia is the larger continent, its eastern interior is more secluded from the influences of warmer seas, and its eastern coast more subject to Continental influences, and thus colder in winter than North America We thus see by the example of Asia that a colder temperature than in Eastern North America does really exist now in the same latitudes. The example of Eastern Asia shows us geographical conditions which tend to produce an exceedingly cold winter. We have but to look at the middle and higher latitudes of the southern hemisphere to see so cold summers that nothing of the kind is met with in the northern I do not know on what authority Dr. Haughton states that the annual temperature of 32° F. is met in the southern hemisphere but on 62° 41′ S We do not have observations during the winter in these latitudes, but the mean temperature of January (the warmest month) is found to be 35·2 on 60° S and 32·4 on 63½° S Or (by the observations of Sir J. Ross) the mean annual temperature can certainly not be less than 4½° below that of January, so that it would be not higher than 30·7 on the 60° S., and 27·9 on the 63½° S

St. Petersburg, February 5 A. WOEIKOFF

Variable Stars

WITH reference to your remarks on variable stars in the Astronomical Column of NATURE, vol. xxiii. p 206, I beg to send a few observations made by me (on some of the stars referred to) during the past few years:—

5 35 Camelopardi October 1875 I found this star about 6½ m. and fainter than *o* (27 Fl.).—October 6, 1879 7 mag.; about 1 mag less than *o*.

6 Rumker's star I have the following observations: March 27, 1875. About 7 m.; fainter than 25 Monocerotis—January 19, 1876 6¾ m.; less than 25, but brighter than two 7 m stars *s.f.* it—March 18, 1877. Distinctly visible to the naked eye; about 6 m, but less than 25 (5·6 m. Heis). The above observations were made in the Punjab

7 65 b^3 Geminorum. December 1, 1880 65 so exactly equal to 64 Geminorum with opera glass that I could see no difference between them in magnitude.

8. 16 Leonis Minoris. March 27, 1875. About 7½ m.—January 19, 1876. 7·3 or 7·5 m.

10. Lalande 38405. August 31, 1877, I found this star fainter than Lalande 38388, which lies about 20′ north of it, also less than a 6 m Harding (Lalande 38214) *s p* it. Brighter than Lalande 38342 (7½, 8), which lies *n.p.* it.

11. 33 Capricorni August 1875 I estimated this star as 6½ m.; August 1876, 6 m., and slightly brighter than 35 Capricorni.

12 ι (17) Andromedæ. From numerous observations, beginning in May 1875, I have detected a variation in the light of this star to the extent of about half a magnitude. It is sometimes distinctly brighter than κ Andromedæ, and sometimes decidedly fainter.

With reference to β and δ Scorpii I find the following observation in my note-book —

"Punjab, August 10, 1876. β Scorpii (2 m. Heis) and δ Scorpii (2·3 m. Heis) almost exactly equal. Perhaps δ, if any thing, *very* slightly the brighter of the two. J E. GORE

Ballisodare, Co. Sligo, Ireland, February 5

The Mode of Flight of the Albatross

THERE seems to be a prevailing idea that the albatross in his flight is in some way "assisted by the wind" I think this is a mistake, the manner is well known The method I believe admits of a very simple explanation. His secret consists in his power of acquiring great momentum together with the large superficial area of his extended wings; with scarcely a motion of his wings he will fly straight against a strong wind with a velocity greater than that of any racehorse, this is inconsistent with the idea of his being "assisted by the wind."

In attempting to rise from the water (I believe he is unable to rise from the land or from a ship's deck) he flaps his wings violently to get his body out of the water, at the same time, paddling rapidly with his webbed feet, he acquires a moderate degree of momentum, sufficient, with outstretched wings, to carry him forward and upward upon an easy incline. The case is similar to that of a boy taking a run with his kite string in his hand to give his kite a start. During this first rise he will generally give a few heavy, lazy flaps, and then stretch his wings steadily to their full extent, now as he gradually rises he must of course as gradually lose his acquired momentum till it suits him to acquire more, when he may be twenty, thirty, or fifty feet above the surface, but a much greater distance from the place where he left the water, measured on the surface, by slightly altering his position, by a movement of his tail, he takes a shoot downwards at any angle that suits his convenience, still without his wings outstretched This is precisely the case of a boy shooting down a coast on his sled, the propelling force is the same. The bird directs his course mainly with his tail, the action of which upon the air is identical with the action of a ship's rudder upon the water By this downward motion, his velocity rapidly increasing, he acquires a degree of momentum sufficient to carry him up again to a height equal to or greater than that from which he started. In this up and down long wave-like motion, with all its variations on either side, consists the whole of his flight day after day for hundreds of miles, at long irregular intervals he may give a few lazy flaps with his immense wings Other birds use the mode of flight of the albatross, but to a smaller extent, for the reason, in the case of smaller birds that, the ratio of feathers to bulk being greater, their specific gravity is less, consequently they are unable to acquire the degree of momentum necessary to carry them upward; but on the other hand they have the power of sustained effort in moving their wings rapidly, which the albatross has not Gravitation then, which prevents him from rising directly on the wing, is the motive power of the albatross when aloft He must always take a run or paddle over the surface of the water in order to get a start, and on the land or the deck he is a prisoner, because he has no water in which to paddle himself along with his webbed feet, and he is unable to run. Instead of being assisted by the wind, his speed is lessened by just so much as the wind's velocity, when it happens that the direction of the wind and his intended course are opposed to each other, but with the wind his speed is just so much greater than it would be in a calm.

I do not advance this explanation as an imaginative theory. I claim more for it I have had many opportunities of studying the movements of the albatross for consecutive days, and I feel confident that the above will be found to answer all required conditions. HOWARD SARGENT

Cambridge, U.S.

[1] Nearly one degree to the North of Victoria

Auroral Phenomena

IT is perhaps worth a note that my daughter saw at Folkestone a very unusual phenomenon on the evening of January 25, a little before 6.30. Some distance to the left of Orion (for the night was clear and starry) she observed a small cloud of a bright golden hue, from which streamers of great brilliancy darted in various directions, the cloud alternately paling and brightening. She describes the streamers as like small meteors, leaving trails of light behind them. C. M. INGLEBY

Athenæum Club, February 12

Ozone

IN reply to Mr. Capron (NATURE, vol. xxiii. p. 219) the following explanation may perhaps serve:—

On a flat piece of brass two strips of paper are laid, one plain white, the other prepared. With a clean camel hair brush they are moistened liberally with pure alcohol. This is then burnt off, firing it with a spirit flame; the plain paper remains *clear* and *white*, the prepared paper (beginning at the edges) gradually changes to a *purple brown*. On immersing both strips in clean water the plain paper still remains white, prepared paper changes to a deep purple (No. 8, Negretti's scale).

In about an hour this deep purple colour fades away *precisely in the same way as if the slip had been ozonized by exposure for a day or two to the air.* It may be added that if the prepared slip is not plunged into water the purple brown tint remains for several days.

The experiment suggested by Mr. Capron has been made, using a very delicate gold leaf electrometer. When this is uncharged there is no apparent effect; when charged either directly or inductively with either positive or negative electricity the gold leaves collapse, the charge appearing to be dissipated with the flame.

I may add, when the leaves are *charged* the alcohol is lighted on the plate of the electrometer with a glass rod dipped in alcohol, care being taken to prevent the discharge by conduction. The above experiments have been performed in an ordinary study, but I cannot say they are very conclusive.

Mr. Capron states "ozone is very strong just now," and he obtains No. 10 (Negretti's scale) at an inland town. This is a very high number. I have repeatedly obtained this number at Hunstanton on the Wash (Norfolk), where I made experiments daily for a month. The ozone cage was kept in the shade, a fine cloudless day with cold north east wind blowing, and one day's exposure. I have been engaged for some years in testing for ozone on the coast to see if its abundance, or deficiency, is in any way dependent on the physical and geological conditions of the shore. My experiments are not sufficiently advanced to be published, but the three following conditions have always been found to be present where ozone is abundant:

1. A long sandy shore exposed for some hours to the sun's rays.
2. Cloudless sky, with cold north or east wind.
3. An abundance of phosphorescent light from the presence of *Noctiluca miliaris* with the evening flow of tide.

This town is singularly deficient in ozone. After numerous experiments I have as yet only obtained No. 1 (Negretti's scale). Whether this deficiency may not have some connection with our notoriously great infantile mortality of the autumn is a question for further consideration. J. P.

Leicester, January 27

Citania

I HAVE not had an opportunity of reading NATURE for some time, but I am told that in a late number there is some mention of a so-called "Pompeii" near Braga in Portugal.

I do not presume to write as a learned antiquarian, but having lived for some years within thirty miles of Citania, and having often visited the place and examined the ruins with a wish to gain some explanation of their mystery, I venture to write as an ordinary witness.

In no sense can Citania be described as a Celtic Pompeii; it is merely a collection of circular buildings erected so close to each other as almost to touch, and grouped on the top of a hill which runs out as a spur from the higher ground behind it, and overlooks the rich valley beneath it. The walls have fallen, and the stones which composed them remain *in situ*, generally visible, though more or less overgrown with grass. From the foundations it seems that these round houses must have been some ten feet in diameter internally, with walls eighteen inches thick. The original height of the walls may be inferred, from the quantity of stones fallen, to have been some twelve or fifteen feet.

My utmost examination discovered scarcely anything beyond some shattered bits of coarse pottery. But over the surface of the hill there are still lying about many well shaped round stones about twenty inches in diameter, which I always thought to be hand millstones. These seemed to me to afford the most likely solution of any mystery connected with the place, and I inferred it was a place of security, to which the corn of the district round was carried. The apparent absence of water forbade the supposition that it was a place of permanent abode. I never could see any necessity for referring its origin to Celtic time. The buildings were probably used, and possibly only date from much later days. Remembering the condition of that district as being the debatable ground lying between the Asturian kingdom in the north and the moors in the south, and open to sudden and transient incursions from either side, the utility of such a place to the farmers of that district seems evident. A Portuguese gentleman, whose name I forget, has so far interested himself in the place as to rebuild one of the circular buildings in what he conceives its original condition, and inside he has collected any remains of antiquarian interest that he could scrape together. Unfortunately his enthusiasm for forming a kind of local museum has led him to carry to it what never belonged to the place. For outside his museum there is a large granite slab, which in character is utterly foreign to the place, and long mystified me. This "Pedra Formosa," as it is called by the neighbouring villagers, is about nine or ten feet long, six feet high, with an average thickness of one foot, and must weigh six or seven tons. It looks like a pretentious *façade* stone, which has survived the building to which it was once attached. It has some carving about it, and signs which may or may not have any meaning in them. But whatever the stone was, it has no right to be where it is; for one day, in a conversation with a local farmer at the inn in the valley, I learnt the fact that some years ago all the farmers of the neighbourhood combined, and yoking thirty nine pair of bullocks together, dragged the said stone from the valley below, where from time immemorial it had been lying, and added it in triumph to the other objects of the museum.

I may add that during my stay in Portugal I corresponded with the late Senhor Herculano, the Portuguese historian, on the subject, and I believe I have stated his conclusions.

R. BURTON LEACH

Sutton Montis Rectory, Castle Cary, February 8

The Recent Severe Weather

YOUR correspondent H. W. C. in his communication on the above in NATURE, vol. xxiii. p. 329, quotes Mr. Lowe's theory of an eleven-year cycle of "great frosts," and after giving the dates upon which that theory is apparently based, says "There are some variations in the lengths of the intervening periods, *but there is a distinct recurrence of eleven-year epochs.*"

With the first part of this sentence I quite agree, but I fail to see the very least ground for the latter part of it, the intervals taken in order being as follows:—9, 3, 6, 18, 3, 16, 4, and 10 years. Three intervals approximating to eleven years can be "screwed" in by manipulating the years between which you reckon, disregarding inconvenient ones and using others which suit better; but surely this cannot be held sufficient to justify the statement, such a method of dealing with the figures being, it is scarcely necessary to point out, quite unallowable.

I have noticed before that when the discovery of similar epochs for abnormal heat, cold, rain, &c., have been announced, a similar method of dealing with dates has been followed to that which seems to have been adopted in this case. F. M. S.

February 3

THE epochs which show recurrence are obtained by "manipulating" the figures in the following manner:—

December	1801	to January	1814,	interval	12	years	2	months.
,,	1810	,,	1820,	,,	9	,,	2	,,
,,	1840	,,	1861,	,,	20	,,	2	,,

(It should here be remarked that a *long* but not "great" frost was experienced in the winter of 1849-50, as it was not severe enough to entitle it to the designation of great frost it was

omitted from the table, if it had been inserted the 20 years and 2 months period would have counted as two 10 year periods.)

December 1860 to January 1841, interval 10 years 2 months
„ 1870 „ 1881, „ 10 „ 2 „

Thus at least four periods (out of a possible seven) do not require much "screwing" to make them approximate to 11-year epochs; while if we were to add in the *long* frost of 1850 we should have no less than six periods, showing a distinct recurrence.

It may not be quite clear why the remaining dates are inserted, but if they are analysed in the following manner they are not uninstructive.

December 1813 to January 1838, interval 22 years 2 months.
„ 1837 „ 1857, „ 19 „ 2 „

These periods, like the one 1840 to 1861, tend to show that the intervals approximate nearer to 22 years. How does F. M. S. obtain the intervals he quotes? As regards the last paragraph of the letter of F. M. S. respecting the "abnormal heat, cold, rain, &c.," it is only necessary to say that he would have considerable difficulty to prove to Norman Lockyer, Meldrum, and others, that 11-year cycles do not exist, even if F. M. S. "screwed" his figures, as he seems to have done in his letter above. H. W. C.

Butterflies in Winter

A COUNTRYMAN has shown me to-day two fine specimens of *Vanessa urtica* in a lively condition caught on the 4th inst. in an empty room on the border of the New Forest, exposed to the severity of the late frost. THOMAS W. SHORE

Southampton, February 8

JOHN GOULD, F.R.S.

THE grave has recently closed over the remains of a very remarkable man, and although the annals of science, we are proud to think, afford many instances of indomitable energy and unceasing perseverance rewarded, they have no greater record of success than is to be found in the life of John Gould. No one can regard the series of works written and illustrated by him without acknowledging that they are a monument of human energy, and the story of his life makes the fulfilment of these large enterprises the more interesting. In the character of the man we must look for the secret of his success, because it is well known that he possessed neither the advantages of wealth nor education at the commencement of his career, and yet he has left behind him a series of works the like of which will probably never be seen again, and this because it is rare to find the qualities of a naturalist, an artist, and a man of business combined in one and the same person. John Gould was all these in an eminent degree; he knew the characters of birds as well as any man living, and although it has often been said that he made too many species—and latterly it has been the fashion with certain writers to sink a good many of them—yet the monographer, travelling over the ground again, generally finds that the critic, and not Gould himself, was at fault. As an artist he possessed talent combined with the greatest taste, and this, added to the knowledge of botany, acquired in his early days, enabled him to give to the world the most beautiful series of pictures of animal life which have yet been produced. Certain special works, where the pencils of Wolf or Keulemans have been employed, many vie with those of Gould, but taken in a collective sense, his splendid folios, full of coloured plates, are as yet without a rival. That he was a good man of business the fact that his writings were not only self-supporting, but further realised him a considerable fortune, is the best proof. Though in outward seeming he was stern and even somewhat brusque in manner, those who knew him well can vouch for the goodness of his heart, and can tell of many an act of kindness and charity, concealed from the world under a bluff exterior, and no one ever heard him speak unkindly of any of his contemporaries. Straightforwardness was one of his especial characteristics, as well as an exact manner of doing business, paying for everything the moment the work was done, and this probably accounts for the way in which his artists, lithographers and colourers, worked for him for long periods of years.

Mr. Gould at his death was in his seventy-seventh year, having been born in September, 1804. He was a native of Lyme in Dorsetshire, but when quite an infant his parents moved to the neighbourhood of Guildford. When he was fourteen years of age his father was appointed a foreman in the Royal Gardens at Windsor, under Mr. J. T. Aiton, and here the lad had a grand opportunity of studying British birds in a state of nature; in his collection are still to be seen two magpies shot by himself and stuffed at the age of fourteen, which are even now most creditable specimens of taxidermy, and foreshadowed the excellence which he afterwards attained to in that art. Till the year 1827, when he came to London, he was still employed in active gardening, having left Windsor for a post at Sir William Ingleby's at Ripley Castle in Yorkshire. Immediately after coming to town he was appointed curator to the Zoological Society's Museum, at that time in its infancy, and he enjoyed the intimate friendship of Mr. N. A. Vigors, then one of the leading English naturalists, and through him John Gould received his first opportunity of appearing as an author. So rare were Himalayan birds in those days that a small collection was thought worthy of description by Mr. Vigors in the *Proceedings* of the Zoological Society, and the figuring of these specimens was commenced by Mr. Gould under the title of "A Century of Birds from the Himalayan Mountains." By this time however an event had taken place which had an influence on the whole of his later life, viz., his marriage with Miss Coxen, the daughter of Mr. Nicholas Coxen of Kent. Besides her other accomplishments Mrs. Gould was an admirable draughtswoman, and, from her husband's sketches, she transferred to stone the figures of the above-named work. Its success was so great that in 1832 the "Birds of Europe" was commenced, and finished in five large folio volumes in 1837, while simultaneously, in 1834, he issued a Monograph of the Rhamphastidæ or family of Toucans, and in 1838 a Monograph of the Trogonidæ or family of Trogons. To the last he maintained his love for these birds, and one of his most recently finished works was a second edition of the last-mentioned Monograph. It is a curious fact that when John Gould proposed to publish his first work, he applied to several of the leading firms in London, and not one of them would undertake to bring it out, so that it was only with reluctance that he began to issue the work on his own account. Besides these larger publications he had described the birds collected during the voyage of the *Beagle* by his friend Mr. Darwin, and had contributed papers on other subjects to the Zoological Society's publications.

We now come to what we consider the most striking incident in Mr. Gould's life, one unsurpassed in its effects in the annals of ornithology. Beyond a few scattered descriptions by some of the older authors and an account of the Australian birds in the museum of the Linnean Society, by Messrs. Vigors and Horsfield, the birds of Australasia were very little known at the date we speak of. Accompanied therefore by his devoted wife, Mr. Gould proceeded in 1838 to study Australian birds in their own home, and he personally explored Tasmania, the islands in Bass's Straits, South Australia, and New South Wales, travelling 400 miles into the interior of the latter country. This voyage, specially undertaken for the purpose of obtaining an exact knowledge of Australian birds, must ever be reckoned as a distinct scientific achievement, and the accounts of the habits of some of the more remarkable species, such as the mound-building Megapodes and the Bower birds were quite triumphs in the way of field ornithology. Nests and eggs were collected as well as an excellent series of skins, both of mammals and birds, and here Mr. Gould's beautiful method of

preparation was especially noticeable, some of his specimens, skinned more than thirty years ago, are as neat in appearance and as fresh as the day they were prepared. Returning in 1840, after two years' absence, he commenced the great work on the "Birds of Australia," which makes seven folio volumes and occupied seven years in its production, being completed in 1848 One of the features of this work is the great increase in our knowledge of the range and habits of petrels and other sea-birds, to which the author paid great attention during his travels.

Within a year of Mr Gould's return from his adventurous voyage he had the misfortune to lose his wife, and for some time he was completely overwhelmed by his bereavement His collectors in Australia too, about the same period, lost their lives, one of them, Mr. Gilbert, was killed during Dr Leichhardt's expedition overland from Moreton Bay to Port Essington, and Mr Drummond, while collecting in Western Australia, was also murdered by natives, and a third collector was killed by the explosion of a gun on one of the islands of Bass's Straits It speaks volumes however for the zeal and energy with which Mr Gould had prosecuted his researches in the Australian continent that very few birds, sufficient only to form a supplement in a single folio volume, have been discovered since he left the field of his labours in that quarter of the globe

Another landmark in the career of this great ornithologist was the publication of his Monograph of the Trochilidæ, or Family of Humming Birds These lovely little birds had been for a long time favourites with Mr Gould, who gradually began to amass that fine collection which has been the admiration of naturalists for so many years Taking advantage of the Great Exhibition of 1851, he obtained permission from the Zoological Society to erect at his own cost a large building in their gardens in the Regent's Park, where the collection was open to the public at a charge of sixpence per head A considerable sum was realised by this exhibition, and a large number of subscribers to his monograph was obtained, including nearly all the royal families of Europe Though sketched by Mr Gould himself (for even to the last days of his life he executed the designs for all his plates), the majority of the humming-birds were placed on stone by Mr. Richter, who also did the same for Mr Gould's next work, "The Birds of Asia" We cannot but regard this as one of the most valuable of all the works done by the author, for, notwithstanding the fact that it is left unfinished at his death, it contains a large number of plates of species not elsewhere figured The "Mammals of Australia," produced simultaneously with the last-mentioned work, deserved, in Mr. Gould's own opinion, more credit for its issue than perhaps any work he had done, because it touched upon a branch of zoology of which he never pretended to have a very exact knowledge So large however had been his collections of mammalia during his sojourn in Australia that some account of them seemed to be demanded, and he therefore published his large folio work, but the pecuniary results were less satisfactory than with any of his ornithological productions His typical specimens of the Australian mammalia are in the national collection. No sooner were the humming-birds finished than his active brain conceived a new idea, to illustrate becomingly the birds of his native land, and he commenced the publication of the "Birds of Great Britain." Opinions may differ as to the merit of Mr Gould's other works, volumes less ponderous than the folios which he adopted for the better figuring of the objects of the natural size, may take their place with the student; but no work of greater beauty will be produced than that on which John Gould, returning in his later life to his first love, bestowed the fulness of his energy and the acme of his artistic talent. The care bestowed on the plates of this work was remarkable, the aim of the author being to produce a picture of the birds as they appeared in their natural haunts, and especial pains were bestowed on the young, particularly those of the wading-birds and natatores In this fine work most of the drawings were developed and placed on stone by Mr. W Hart, who also executed all the plates of the later works

In 1865 Mr Gould republished his letterpress of the big work in an octavo form, under the title of "A Handbook to the Birds of Australia," but with all the additional species inserted in their proper families, these two volumes are therefore of great use to the student After the completion of his work on "British Birds," Mr. Gould devoted himself to the continuation of the "Birds of Asia" and the Supplement to the "Birds of Australia," until in 1875 he commenced a work on the "Birds of New Guinea," which was to contain also descriptions of any new species to be discovered in Australia or any part of the Australian region Of the last-named work eleven parts have appeared, and it was left unfinished at his death, as well as the following works —a "Monograph of the Pittidæ or Ant-Thrushes of the Old World" (one part published), the Supplement to the "Monograph of the Humming Birds" (two parts published), and the "Birds of Asia"

The above list enumerates, we believe, nearly all the works published by Mr Gould with the exception of the "Icones Avium," issued about 1838, and containing supplementary plates to his previous volumes, with descriptions of new species, and the "Monograph of the Odontophorinæ or Partridges of America" In addition to the folio volumes he was also in the habit of publishing the introductions to his larger works in an octavo form

Many of the above details of Mr Gould's life are taken from "Men of Eminence," aided by the personal recollections of the writer, who was for many years an intimate friend of the deceased, and knew him first as a successful trout catcher on the Thames, for his prowess in throwing the fly was scarcely second to his skill as an artist Were he to write an epitaph of John Gould he would do so in the words which Mr Gould himself was fond of quoting -" Here lies John Gould, the Bird-Man." The latter words were used by an old and intimate friend in introducing Mr Gould to another relative We may hope that the Government, according to the well-known wishes of the deceased naturalist, will allow no false motives of economy to interfere with the purchase of Mr. Gould's collection of birds for the British Museum, and that the disgraceful spectacle of his Australian collection (unrivalled to this day, and offered to the nation for the small sum of 1000*l*) being allowed to leave the country, may not be repeated

THE BLACKHEATH HOLES

THE chalk forming the base of the escarpment between Woolwich and the entrance to the valley of the Ravensbourne, dips it a low angle to the south-south-east under Greenwich Park and Blackheath, where it is overlaid by the Thanet Sands, estimated by Mr Whitaker of the Geological Survey at 40 to 50 feet, the Reading and Woolwich Beds. consisting of shelly clays, sometimes 40 feet thick, associated near Lewisham with fine laminated sands These beds are overlain by the Oldhaven or Blackheath gravels, reaching a thickness of about 50 feet, which have been largely dug for gravel in various parts of the district

In the centre of this tract at Blackheath, on the west side of the angle of the roads from Greenwich Park to Blackheath Station, and from the Park to the Paragon, appeared in the early morning of Thursday, April 12, 1878, a subsidence near the row known as Rotten Row, referred to in these columns at the time, the hole being 8 or 9 yards in circumference In November, 1880, appeared another hole near the gravel pit below Eliot Place

and Heath House, and about 550 yards south-west of the first hole; and still later in that month, on the 19th, a third subsidence made its appearance, this time about 100 yards to the south-east of the first subsidence, and nearer to All Saints' Church.

The Astronomer-Royal and other inhabitants of the district being anxious to know how far other subsidences were probable, asked the Metropolitan Board of Works, who have jurisdiction over the Heath, and who had fenced in the sinkings, to investigate their cause. This however they declined to do, though giving to the Astronomer-Royal permission to do so, this authority he handed over to a newly-formed society, called the Lewisham and Blackheath Scientific Association, who formed a committee of investigation, including members of the West Kent Natural History Society, for which end subscriptions are now being sought, and operations will shortly be commenced, as announced in our columns.

The surface of the chalk is estimated by one member of the committee, Mr T V Holmes, as probably occurring at about 100 feet from the surface at or about the Ordnance datum line. The investigations so far made show the third sinking to consist of an oval vertical shaft 7 feet 8 inches diameter by 6 feet 9 inches, with a depth of 18 feet, opening into a cavity extending in both directions, and partly choked with fallen earth, giving a total diameter, as far as examined, of 14 feet The upper part of the shaft is described by Mr Holmes as consisting of sand and clay resting on sand, overlying pebbles, in which the cavity below is formed The material carefully removed from the bottom of the pit is found by Mr. H W Jackson to be of the same material as the upper beds of the shaft, proving the sinking due to removal of material from below. The first sinking is filled up and cannot be investigated; the second is not fully examined for want of funds, but is wholly in gravel, and also extends underground in two directions.

Various theories have been suggested by different observers to account for their origin, some considering them artificial, Admiral Hamilton that they are caused by the abstraction of water caused by the main-drainage works, which tapped powerful springs in the Lower Woolwich Road, others connect their appearance with removal of chalk, and water in the chalk, by the Kent Waterworks, who lift daily about nine million gallons a day from their wells in the neighbourhood, whilst others connect them with excessive rainfalls, the first subsidence having taken place after the great floods in the Ravensbourne, caused by the rain of the night of the 11th and morning of the 12th of April, 1878

The height of the chalk water-line (*Journal*, Society of Arts, 1877) at Woolwich Dockyard well is about 15 feet below the Ordnance datum line before pumping, at the Kent Waterworks, Plumpstead, 1 foot 4 inches below, but at the Kent Waterworks wells at Deptford it is pumped down to nearly 70 feet below, rising 50 feet after pumping, or about 20 feet below Ordnance datum The surface of the chalk at Bromley, at the Shortlands pumping-station, has risen to 70 feet above the datum, the water rising after pumping to 122 feet above it This district is on the south side of a synclinal axis ranging east-north-east through Eltham, described by Mr. Whitaker, which throws in a trough of London clay, that cuts off this supply, from the chalk water entering at the Greenwich Park escarpment.

The water-level under Blackheath is at, or about, Ordnance datum, trending south towards the London clay synclinal, corresponding, under the site of the subsidences, to the surface of the chalk beneath the Thanet sands, and if there is no great quantity of chalk above the water-level it appears improbable that the subsidences are due to pipes descending vertically into the chalk, but it is quite possible that the drainage works, removing the waters held by the pebble beds above, disturbed their stability, and caused their subsidence. On the other hand it is not impossible that drift levels may have been driven into the chalk from the ancient chalk-pits a mile distant, ceasing when they reached the outcrop of the chalk against the Thanet sand, and which is immediately under the site of the subsidences

C. E. De Rance

MERCADIER'S RESEARCHES ON THE PHOTOPHONE

An elegant series of researches in photophony have lately been published by M E. Mercadier of Paris, who has very carefully examined the phenomenon discovered by Graham Bell and Sumner Tainter, that an intermittent beam of light may generate a musical tone when it falls upon a thin disk. By way of distinguishing this phenomenon and its applications from the phenomenon of sensibility to light exhibited by annealed selenium, which constitutes the essential principle of the articulating photophone, M. Mercadier adopts the name of *radiophony* for the subject of his research, a name which appears moreover to have the advantage of not assuming *à priori* what kind of radiations, luminous, calorific, or actinic, are concerned in the production of the phenomenon. It is agreed by all who have experimented in this direction that the pitch of the note emitted by the disk corresponds precisely with the frequency of the intermittent flashes of light, but it has been disputed whether the effect is due to light or to heat Prof Bell found that the beam filtered through alum water to absorb the calorific ultra-red rays produced tones, and that even when a disk of thin ebonite rubber was interposed, the beam robbed of both heat-rays and light-rays could still generate tones On the other hand, from the list of substances given by the original discoverers, it was evident that since dark and opaque substances with dull surfaces, and those which, like zinc and antimony, have high coefficients of thermal expansion, produce, *cæteris paribus*, the best results, the effects must probably arise from heating effects due to absorption of radiations of *some* kind and their degradation into heat of low temperature

M. Mercadier has summarised his results in an article in the *Comptes rendus*, from which the substance of this article is translated freely The chief conclusions are as follows —

1 *Radiophony does not appear to be an effect due to the vibration of the receiving disk vibrating transversely in one mass as in an ordinary vibrating elastic plate*.— This conclusion appears to be justified by the following observations, that, given a thin plate of any kind, under the conditions necessary for the production of the phenomenon, it produces equally well tones of all different degrees of pitch from the lowest audible up to the highest that can be generated experimentally by optical intermissions, and which in M Mercadier's apparatus attained to a frequency of 700 vibrations per second. Moreover it was found that these changes of pitch were accomplished without any defect in the continuity of the phenomenon, which would seem to indicate that it was not necessary for the plate to vibrate in any particular nodal or partial mode Also the receiving disk will produce *chords* equally well in all possible tones from the highest to the lowest, the chord being complete no matter whether the fundamental pitch be raised or lowered by altering the speed of the rotating apparatus by which the intermittences are produced. M. Mercadier's apparatus consisted of a glass wheel carrying on its surface a paper disk pierced with four series of holes, numbering respectively 40, 50, 60, and 80 Through any one of these series of holes a small pencil of rays could be passed, and, by raising or depressing the axis of rotation of the wheel, could be sent successively through each of the four, thus

producing, at any given rate of rotation, the separate tones of a common chord in succession; or by interposing a cylindrical lens to distribute the rays in a linear beam to the four series at once, the united tones of the chord could be produced simultaneously.

Further it was found that the thickness and the breadth of the receiving-disk makes no difference within certain limits in the loudness or quality of the resulting tone. And in the case of transparent substances such as mica and glass these limits may be wide: in the case of glass the loudness was the same with a disk of half a millimetre as with one of three centimetres thickness. In consequence rare substances may be used in disks as small as one square centimetre in area. Cracked or split disks of glass, copper, and aluminium produce sensibly the same effects as if they were whole.

II. *The molecular structure and state of aggregation of the receiving disk appear to exercise no important influence upon the nature of the tones emitted.*—Disks of similar thickness and surface emit sounds of the same pitch no matter of what material they be. Although there may be slight specific differences between the actual modes of production of the phenomenon from *very* thin disks of different materials, these differences are reduced to a vanishing quantity by rendering the receptive surface alike, as for example by covering them all alike with a film of lampblack. Moreover the effect produced by ordinary radiations is, *cæteris paribus*, the same practically for transparent substances as widely differing from one another as glass, mica, selenite, Iceland-spar, and quartz, whether cut parallel or perpendicular to the optic axis, and is the same in polarised light as in ordinary light.

III. *The radiophonic sounds result from a direct action of radiations upon the receiving substances.*—This proposition appears to be established by the following facts:—1. That the loudness of the sounds is directly proportional to the quantity of rays that fall upon the disk. 2. That by using a polarised beam and taking as a receiving-disk a thin slice of some substance which can itself polarise or analyse light, such as a slice of tourmaline, the resulting sounds exhibit variations of loudness corresponding to those of the rays themselves, when either polariser or analyser is turned; and the sound is loudest when the light transmitted by the analysing disk is a minimum.

IV. *The phenomenon appears to be chiefly due to an action on the surface of the receiver.*—The loudness of the emitted sound depends very greatly upon the nature of the surface. Everything that tends to diminish the reflecting power, and increase the absorbing power of the surface, assists the production of the phenomenon. Surfaces that are rough-ground or tarnished with a film of oxidation are therefore preferable. It is also advantageous to cover the receiving surface with black pulverulent deposits, bitumen black, platinum black, or best of all with lampblack; but the increase of sensitiveness under this treatment is only considerable in the case of very thin disks, as for instance from 1 to ·2 of a millimetre. Very sensitive radiophonic receivers may be thus made with extremely thin disks of zinc, glass, or mica smoked at the surface. It may here be noted amongst M. Mercadier's results that for *opaque* disks, the thinner they are the louder is the sound, and that excellent results are given by metallic foil—copper, aluminium, platinum, and especially zinc—of but ·05 millim thickness. The employment of such sensitive receivers has enabled M. Mercadier to arrive at several other important conclusions.

V. *Radiophonic effects are relatively very intense.*—They can be produced not merely with sunlight or electric light, but with the lime-light, and also with gas-light, and even with petroleum flames, and with a spiral of platinum wire heated in the Bunsen-flame.

VI. *Radiophonic effects appear to be produced principally by radiations of great wave-length, or those commonly regarded as calorific.*—In order to satisfy himself on this point M. Mercadier had recourse to the spectrum direct, without attempting to employ cells of absorbant material such as alum solution or iodine in dissolved bisulphide of carbon as ray-filters. A brilliant beam of light was produced by means of a battery of fifty Bunsen cells, and with this, by means of ordinary lenses and a prism of glass a spectrum was produced, the various regions of which could be explored with one of the sensitive receiving-disks mentioned above. The maximum effect was found to be produced by the red rays and by the invisible ultra-red rays. From yellow up to violet, and beyond, no perceptible results were obtained. The experiment was tried several times with receivers of smoked glass, platinised platinum, and plain bare zinc. The greatest effect appeared to be yielded at the limit of the visible red rays. The rays which affect the electric conductivity of selenium in the photophone are, as Prof. W. G. Adams has shown, not the red rays, but rays from the yellow and green-yellow regions of the spectrum. This fact alone would justify the distinction drawn between the phenomena of radiophony and those of the selenium photophone, though probably these are only two of several ways of arriving at a solution of the problem of the transmission of sonorous vibrations by radiation. Theoretically a telephone with a blackened disk inclosed in a high vacuum and connected with an external telephone should serve as a receiver, and the writer of these lines has already attempted to devise a thermo-electric receiver for reproducing sounds from invisible calorific rays.

S. P. T.

THE JOHN DUNCAN FUND

THE following subscriptions to this fund have been received during the past week:—

	£	s.	d.		£	s.	d.
Amount previously announced	48	6	0	Major Deedes	0	10	0
Charles F. Tomes, F.R.S.	1	0	0	Anon	0	1	3
J. S.	2	0	0	Sir J. Fayrer	1	1	0
Dr. Vacher	1	1	0	T. C. Kent	1	0	0
R. R. Glover	1	1	0	Lawson Tait	1	1	0
Thomas Walker	5	0	0	Heinrich Simon	2	0	0
M. M. Pattison Muir	1	1	0		65	2	3

THE TIME OF DAY IN PARIS

THE importance of precise and uniform time throughout Paris becoming ever and continually more appreciated, the Municipality have taken the matter in hand, and have established a system of what they call "horary centres." These horary centres really consist of standard clocks, erected in different places, and controlled by electricity from the Paris Observatory. Moreover each standard clock is furnished with additional electrical work of its own, which enables it to send out an hourly current and control other clocks in its neighbourhood, placed in circuit with it. The advantage of this arrangement over any system of electrical dials is apparent, for with the latter any mischance or practical joke with the wires would cause the whole city to be misled or completely deprived of time. The problem, as put by Leverrier, and as it has been practically solved by M. Breguet, was this:—To keep correct the hour given by various regulators distributed in the city by means of an electric current sent from the Observatory. If the current, in consequence of any accident, fails, the regulators continue to work, with a very slight advance, without the electric correction. The wires have their centre at the Observatory, where there is an astronomical regulator on the first floor. This instrument is maintained at the exact time indicated by the astronomical observations,

by means of an arrangement which obviates the stopping of the pendulum and changing its length At the bottom of Fig. 1 is a box C, in which may be placed small weights The weights are of such a shape that it is easy with suitable pincers to put them in or take them out without touching the clock or disturbing anything. The addition of a weight makes the regulator go faster; its withdrawal retards it. At the upper part of the pendulum is seen the apparatus by which the currents are transmitted; it is in duplicate, because the pendulum beats seconds, and it is desired to send the current every second Each apparatus is composed of three identical pieces, three small levers are placed side by side, pivoted at their farthest ends Their end *t* is raised by the arm V carried by the pendulum at each of its oscillations During all the time which this contact lasts, the current of a battery passes by the suspension of the pendulum to the arm which carries the three screws and the three levers which conduct it to the line With a single lever there would be danger of interruptions by a grain of dust, with three, contact and transmission of the current are absolutely assured From the Observatory two wires set out, no use is made of the return earth current The wires are entirely in the drains, like those of the Telephone Company Fig 3 shows these two circuits, each of

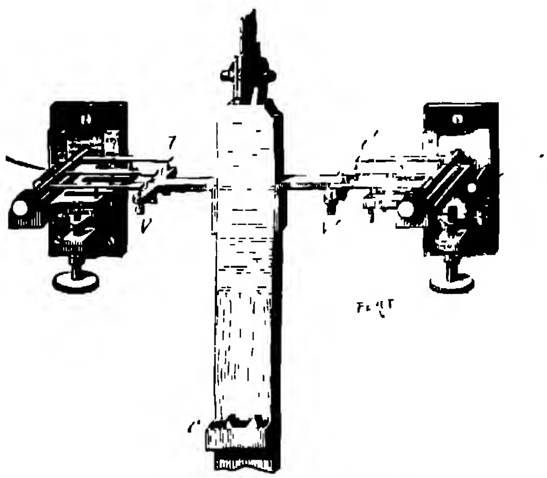


FIG 1—Regulator of Paris Observatory

which is attached to the Observatory by its two extremities These lines pass by a series of points and traverse the regulators, of which we shall now speak, and which are called horary centres The pendulum of each regulator (Fig 2) presents at its lower part a piece of soft iron, which in the oscillations of the pendulum is brought in front of the poles of two electro-magnets in succession. The transmission of the current into these electro-magnets tends to retard a little the movements of the pendulum, and causes each to be perfectly synchronous with that of the Observatory. The regulators of the horary centres show the second, they are placed in the street, and consequently in view of the passers-by, who may thus compare their watches Watchmakers may also thus obtain the exact time without making a journey to the Observatory They are placed in several prominent buildings in various convenient centres.

Why these regulators are called horary centres is explained thus upon the circuit of horary centres spoken of above, and which the accompanying plan (Fig 3) indicates by a black line, is grafted another accessory, called the transmission of the hour Each regulator of the main circuit is itself the centre of a less extensive network of wires, which transmit the hour to the public clocks. For this second service no unique system has been adopted, and uniformity has not been aimed at. Several of the principal watchmakers of Paris, inventors each of a special method of transmitting the hour, are authorised to apply it to the clocks of which they have the care, by borrowing the hour and the current from the nearest horary centre The most interesting horary centre is that installed at the Hôtel de Ville (at present the Tuileries), and which radiates to the twenty *mairies* of Paris. The city has a telegraphic communication which places the Prefecture of the Seine in connection with the twenty *mairies* The wires of this system are interrupted about two minutes every hour to place the clock of each *mairie* into agreement with the regulator (horary centre) of the Hôtel de Ville as follows. Beside the regulator are placed twenty relays, into which it sends every hour a current, which cuts off the line from the telegraph, this commutation is made 100 seconds before the hour The same regulator, about twelve seconds before the hour, sends the current from a second battery along

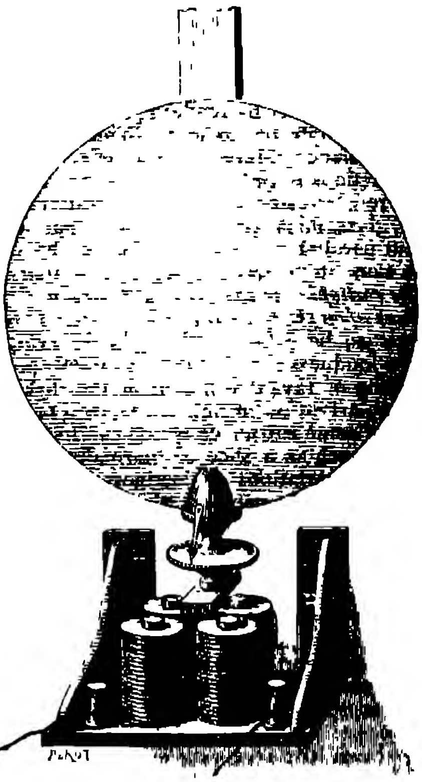


FIG 2—Regulator of the Horary Centre

the lines, it interrupts it at the hour precisely Ten seconds after the hour the relays are restored to their normal position by the suppression of the first current; that is to say, the lines are restored to the telegraph.

On the other hand sixty-five seconds before the hour each *mairie* clock makes its commutation, *i e* cuts off the line from the telegraph and connects it with the electro-magnet of the clock And five seconds after the hour it makes the inverse commutation and restores the line to the telegraph five seconds before the resumption of the line by the telegraph at the horary centre of the Tuilleries. As the clocks are thus regulated every hour their errors are extremely small. If however a clock gets suddenly out of order or stops, what happens? The current of the horary centre is sent into the telegraph of the *mairie* for thirty seconds continuously, this abnormal fact announces at once to the telegraphist that the clock is out of order, and he may give orders to have it set right

In the other horary centres the organisation is less

complicated; it is provided for only six lines, but on each of these may be placed several clocks. The lines are shorter, and radiate only in the quarter which surrounds the horary centre, but they are special to the service of

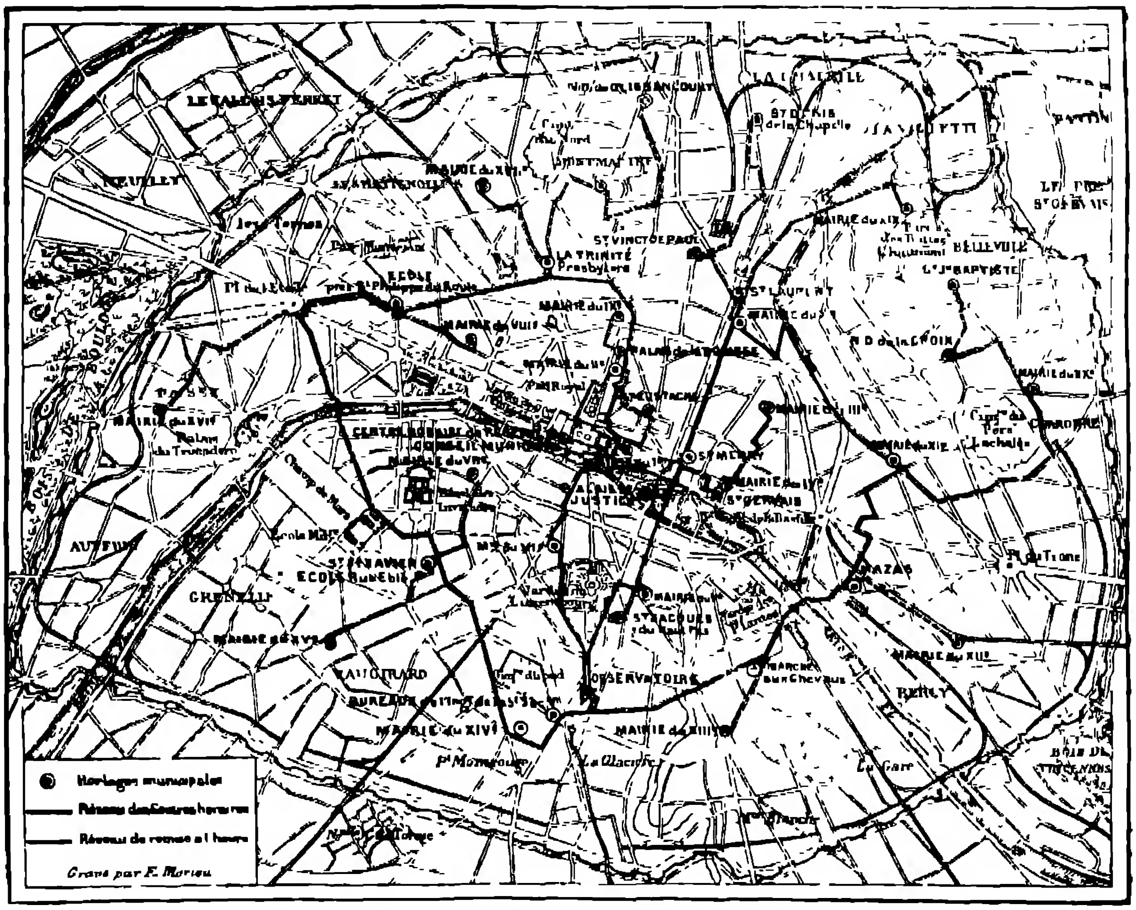


Fig. 3.—Telegraph for the Unification of Time in Paris

clocks, and are not subject to the complicated operation which is necessary on the circuit of the *mairies*. This service has been organised under the direction of the City Engineers, and does them the highest credit, no doubt it will be gradually developed, so as to include the whole of the *mairies* of Paris.[1]

NOTES

THE honour of knighthood is to be conferred on Dr. James Risdon Bennett, F.R.S., President of the Royal College of Physicians.

M. MARCEL DEPREZ, the well-known electrician, has been created a Knight of the Order of the Legion of Honour.

THE first volume of the U.S. Geological Survey, issued under the headship of Mr. Clarence King, is a magnificent quarto by Prof. O. C. Marsh—"Odontornithes: a Monograph on the Extinct Toothed Birds of North America"; with thirty-four beautifully executed plates and forty woodcuts. We hope to refer in detail to Prof. Marsh's work very soon.

IN the House of Commons on Tuesday Mr. Shaw-Lefevre said that both the botanical and mineralogical collections have been already removed from the British Museum to the new Museum of Natural History at South Kensington, and are now being arranged there. It is expected that these collections will be open to the public on the next bank holiday—namely, Easter Monday, April 18.

THE Paris Exhibition of Electricity will contain a number of curiosities. M. Salignac will present to the Director General a plan for cooking by electricity in the grill-room of the restaurant. This plan should provide useful work during the day for the magneto-electric machinery, and test its warming power. M. Michels, an American residing in Paris, has patented a revolving carbon which can be rolled like an ordinary conductor.

WE have now more detailed information about the earthquake which was felt in the Swiss Jura on January 27 at 2h. 18m. p.m. There were two shocks at an interval of five seconds. They were felt especially at Berne, where several chimneys were thrown down, the bell of a church sounded, and the ceiling of a school fell down. At St. Imier the shocks were also rather strong. They were felt also at Neufchâtel, Corcelles, Fontaines, Colombier, Auvernier, and Chaux de-Fonds to west; at Morges (but not at Lausanne) to south-west, at Solothurn, Basel, and Zurich to north and north-east; and at Signau, Huttwyl, Berthoud, and Thoune to south and south-east. Two smaller shocks were felt: one on the same day at six o'clock in

[1] From an article in *La Nature*, by M. A. Niaudet.

the evening, and the other at three o'clock on the morning of the following day.

SHOCKS of earthquake were noticed at Baraccone, Italy, on January 31, at 8.30 p.m.; at Fiume, Hungary, on the night of January 3-4, at 2 26, direction, north-east to south-west, duration, two to three seconds, in Upper Italy, *e.g.* at Ancona, on the night of January 3-4

THE incredulity with which the news about an earthquake at St. Petersburg was met in some quarters, when M. Wagner described it some years ago in consequence of quite unusual oscillations of the level of his transit instrument at Pulkova, seems to be unfounded. We learn from Russian papers that on January 26, at 2 15 p.m, an earthquake was felt at Narva and at the Korff railway station, as well as on the estates of Lagen and Repnik, seven and eight miles distant from Narva At all these places it was accompanied with a subterranean noise.

AT the Observatory of Pawlowsk, Russia, extraordinary magnetic perturbations (variations 2°) were noticed on the evening of January 31 On the same evening an auroral display was visible in different parts of the Russian Empire, *e g.* in Western Siberia, at Ekaterineburg and Irbit (Ural), at Baltishport, and at Hasenpoth

ON Saturday evening last the President of the French Republic, accompanied by all the members of the Government, visited the Paris Bourse in order to witness some experiments with Mr Graham Bell's photophone. M. Antoine Breguet began by explaining the principles of the wonderful invention, after which experiments were made over a distance of fifty metres, by means of an electric light produced by a Gramme machine and a Sernn lamp.

M. BOGDANOFF, who took part in the Russian North Sea Expedition sent out during last summer, communicated, at the general meeting of the St. Petersburg Society of Naturalists, his observations on the influence of whaling on the fishing on the Normannic coast, which illustrates very well the complicated chain which exists in the animal world. The whale used to be very important to the fisheries, as during the spring it drove to the coast immense shoals of small fishes. Now, whaling being pursued by means of steamers which use a bullet instead of the old harpoon, and the annual number of whales killed being, during the last seventeen years, from 50 to 143, the amount of small fishes coming to the coast has much diminished. Besides, the great quantities of fat which are thrown into the sea at Varanger attract sharks, and these last destroy cod-fish, so that now the cod-fishing is nearly extinct in the western parts of the Varanger fjord region.

MR WALLACE in his "Island Life," pp 495, 496, has discussed the apparent inability of Australian plants to become naturalised in the northern hemisphere The gist of his explanation is the want of elasticity in their constitution, owing to their long-continued insular and uniform conditions of existence The accompanying extract from the Report of the Government Gardens at Rangoon for 1880 points to the incapacity of even the vegetation of Tropical Australia to stand really humid climatic conditions —"The Australian Eucalypti grew well during the dry weather, and some of them were four feet in height when the monsoon commenced, they then damped off one after another, as did also the Australian Acacias and the Queensland Ficus. The Moreton Bay Chestnut is not flourishing From the above it will, I think, be evident that plants of Tropical Australia will not readily accommodate themselves to this very moist climate." It may be added that the result of attempting to grow species of *Eucalyptus* from all parts of Australia in the West African Settlements has uniformly failed, and apparently from the same cause.

SOME experiments have been made at the Cawnpore Experimental Farm during 1879-80 on the cultivation of imported English and American wheats and barleys. The result seems to point to the conclusion that the time available for the growth of cereals in India is too short to allow of English and American varieties being grown with success unless possibly the seed is sown in September and runs a risk of being damaged by excessive heat. Experimental sowings were made of three kinds of English and three kinds of American wheat, as well as of three kinds of barley All nine sowings were complete failures. The seeds in most cases germinated freely, and the plants spread out into stools in a manner very different to the habit of country wheat But all crops grew extremely slowly, and were still green when native wheat had finished ripening. In consequence the hot winds of March completely shrivelled up whatever grain had been formed, and no crop worth the name was gathered.

THE Manchester Field Naturalists' Society has recently attained its majority, and the event has been marked by a social meeting of past and present members in honour of the founder, Mr Leo Grindon, author of "Manchester Walks and Wild Flowers," &c In 1860 Mr Grindon gathered around him a company of friends wishful to make some acquaintance with nature, and fortnightly summer excursions were established under his pleasant guidance. A prominent feature of the Society's proceedings has been the winter *soirées*. Now that the possibility of establishing a successful society, whose aspirations may be thought by some incompatible with commercial pursuits, has been demonstrated, the executive will do wisely to thoughtfully extend their operations in the direction of the Society's aims. Some attention has been paid to such practical matters as tree planting in towns and window-gardening, and the discussion of such questions will tend to give a firmer hold upon public favour Lancashire contains an unusual number of field-clubs, some of which have been inspired by this Society, whilst others were earlier in existence. In one of his letters the late Mr Carlyle laments that "for many years it has been one of my constant regrets that no schoolmaster of mine had a knowledge of *natural history*, so far at least as to have taught me the grasses that grow by the wayside, and the little winged and wingless neighbours that are continually meeting me with a salutation which I cannot answer" Had he been a native of Lancashire he would have found many instructors willing to read him the lessons of the wayside

ON the 9th inst the Dundee Naturalists' Society held their sixth annual *conversazione*, which seems to have been quite successful. All sorts of scientific *matériel* were exhibited, and among other lectures given was one by Dr McIntosh of Murthly on Sponges. This society is evidently in a flourishing condition, and is no doubt doing something to create an interest in science in the important seaport in which it is located.

MR. QUARITCH has just issued the second part of his new Catalogue of Works on Natural History. It seems to contain a large number of very scarce and valuable works.

A FEW months ago three large blocks of petrified wood were found in the Devonian bed at Doppersberg, Germany. They were recognised by Prof. Goppert of Breslau as belonging to a fossil Araucaria, named by him *Araucarites Elberfeldensis* (Doppers).

THE Baltic Centralverein fur Thierzucht und Thierschutz will hold its third exhibition of domestic birds on March 11-13 at Greifswald. In addition the exhibition will include living and dead freshwater and marine fish, fish embryos, &c., and all apparatus pertaining to pisciculture and fishing.

AN important step has been attained in telephony by Dr Cornelius Herz, by which the principle of magnetism has been entirely discarded and the magnetic receiver abolished. A long series of experiments have been successfully conducted under the patronage of the French Government on the telegraphic lines of the State, concluding trials were witnessed, among others, by M Cochéry, Minister of Postal Telegraphy, M. Jules Ferry, Prime Minister, M. Leon Say, President of the Senate, M. Becquerel, and other Members of the Academy of Sciences, and other Members, Senators, Deputies, and a great number of engineers. One of the most extraordinary experiments was the transmission of speech on a single wire from Tours to Brest, on a wire passing through Paris, the length of which exceeded eight hundred miles. One single Leclanche's element was the sole battery in use.

SOME dredging work which is going on at Zurich in the bed of the Limmat has brought to light the shore pillars of a Roman bridge, as well as the skeleton of a prehistoric stag.

INTERESTING new discoveries have been made at Pompeii In block 7 of the 9th district a house has been excavated which was in course of construction when the terrible catastrophe occurred, and which differs materially from all other Pompeiian houses in its plan In another house a large square piece of black glass was found fixed into the wall, which when slightly moistened forms the most perfect mirror In a third house various wall paintings were discovered, which however are rather of artistic than scientific interest

THE newly-elected Municipal Council of Paris has been summoned by the Prefect of the Seine for a session which will begin on the 11th inst It is stated that one of the proposals made will be to establish in Paris a system of police telephonic stations, as practised in Chicago

M. JULES FERRY has created a library for patients in every hospital in Paris. The system will be extended to the whole of France.

AT the meeting of the Royal Academy of Sciences at Berlin on January 27 last, the year's report (for 1880) for the Humboldt Institution for Natural Research and Travels was read Prof. du Bois Reymond, in conjunction with Prof. G Fritsch, is about to publish the observations and experiments made by the late Dr Karl Sachs on *Gymnotus electricus* in South America during 1876 and 1877, by order of the Institution. The present traveller of the Institution, Dr. Otto Finsch, after staying for nearly a year upon Talint Island (one of the Marshall group) proceeded to Matupi (on the north coast of New Britain) at the end of last year. His last letter is dated October 27, 1880, and he announces that he has made rich zoological collections He intended to visit New Ireland and New Guinea if possible, and then to return to Europe by way of Dutch East India Four of Dr. Finsch's collections have arrived at Berlin, a fifth is announced by his first letter from Matupi. The funds of the Institution have been increased by small legacies The sum which will be at the disposal of the Institution for 1881 is 12,750 marks (635*l*)

THE Sydney correspondent of the *Colonies* writes —"We have long had in Sydney splendid botanical gardens, containing the choicest plants in the world, but we have only recently started a 'Zoological Gardens,' though Melbourne has had one many years, which has been brought to a high degree of perfection. Last week a deputation waited on our Colonial Secretary, asking for funds to stock the Gardens. Sir Henry Parkes replied that if the members of the Zoological Society would undertake next year to put as many animals in the grounds of the Sydney Zoological Gardens as they have in Melbourne, he would guarantee them 10,000*l*. from the Government. The offer was not accepted."

THE *Chrysanthemum* is the title of a monthly magazine "for Japan and the Far East," the first number of which has been sent us. The contents are mostly of a literary character, the main object of the magazine being "to aid in bringing the pales of Eastern and Western thought into such contact as may result in the diffusion of a general warmth and light around us." The publishers are Kelly and Co of Yokohama, the English agents being Trubner and Co.

A SKELETON of a mammoth has been discovered at Bendery, Government of Bessarabia, in the upper clay drift.

THE St Petersburg Society of Naturalists has already 276 Fellows, the Mineralogical Society has 398 members.

THE Commission of Fisheries of the United States have sent a quarter of a million ova of the American whitefish to Bremen, *en route* for the Lake of Constance, where the attempt to acclimatise this fish is to be made.

THE centenary of the birth of the philosopher Karl Christian Friedrich Krause will be celebrated on May 6 next at his birthplace, Eisenberg (Saxe-Altenburg). At the same time a simple monument with a bronze bust of Krause will be unveiled The design is by Herr Enger of Altenburg, the bust by Robert Henze of Dresden. A Krause Scholarship has also been established at the Gymnasium.

WE have on our table the following books.—"Practical Plane Geometry," John W Pallister (Simpkin), "Introduction to Study of Indian Languages," J. W Powell, "Journal of Iron and Steel Institute, 1880" (Spon), "Practical Botany," D Houston (W Stewart), "Popular Scientific Lectures," 2nd series, Helmholtz (Longmans), "The Evolutionist at Large," Grant Allen (Chatto and Windus), "Journal of Royal Society of New South Wales," "Extinct British Animals," J. E. Harting (Trubner), "Calendar of University of Wales, 1880-81," "The Silk Goods of America," 2nd edition, W. C. Wyckoff; "London Catalogue of British Mosses" (Bogue); "The Statistical Atlas," part 1, G. P. Bevan (W. and A. K. Johnston), "Kamelaroi and Kurnai," Fison and Howitt (Macmillan and Co.); "Meeresfauna," K Mobius (Otto Enstin), "Annuaire pour l'an 1880" (Villars, Paris), "A Polar Reconnaissance," A. H Markham (Kegan Paul); "Natural History of British Fishes," Frank Buckland (S.P C K.), "Ventilation and Heat," Frederick Edwards (Longmans); "Practical Physics," A H. Worthington (Rivington), "Muscles and Nerves," Dr. T. Rosenthal (Kegan Paul), "Natural Philosophy Examination Papers," Rev G. Molloy (Browne and Nolan); "On some Properties of the Earth," O. Reichenbach, "Evolution, Expression, and Sensation," John Cleland (Maclehose, Glasgow), "The Wild Coast of Nipon," Capt. H C. St John (Douglas).

OUR ASTRONOMICAL COLUMN

THE SO-CALLED NOVA OF 1600.—Referring to a note which recently appeared in this column on "Janson's Star of 1600," Prof van de Sande Bakhuysen, Director of the Observatory of Leyden, writes us that "Janson or Gulielmus Jansonius is Willem Jansz Blaeu, who is well known as the maker of globes, which are now very rare, and as editor of a treatise on the use of globes, of different treatises on navigation, and of a great number of charts and different atlases. From 1598 till his death in 1638 he lived in Amsterdam Janson signifies that he was the son of Jan (John), but his family name was Blaeu" This explanation will be acceptable to those who may have been perhaps somewhat in doubt as to the correct form of identifying the discoverer of the variable star of 1600, Kepler styled him Jansonius, without reference to what Prof Bakhuysen states to have been his surname; and he is frequently called Jansen. Lalande refers to the globes constructed by Blaeu as the best of the period, and the fact of his remarking the star in question, of which there is no previous mention, proves that he was a careful

observer of the heavens. In the *Bibliographie Astronomique* we find an astronomical work printed in 1625, attributed to him as Willem Jansz Blauw.

It will be seen from the works of Kepler and Cassini that Blaeu's star (34 Cygni of our present catalogues) at no time rose higher than the third magnitude, though even Madler (*Populare Astronomie*) has so far overlooked its history as to tell us "it reached the first magnitude", and he attributes its discovery to Kepler.

THE "ASTRONOMISCHE NACHRICHTEN"—Contrary to what has been lately stated, it appears that this periodical will still be edited by Dr. C. F. W. Peters, who has for some time conducted it, and we are informed there is a probability that Prof. Kruger may set afloat a new astronomical journal under his own management. Whether the multiplication of high-class astronomical journals to the extent we are likely to witness is a practical advantage may perhaps be doubtful. For many years the *Astronomische Nachrichten* contained almost all that bore upon the progress of exact astronomy; *sed tempora mutantur, et nos mutamur in illis*.

THE COMET 1880 *e* (SWIFT, OCTOBER 10).—The completion of the mounting of the large Merz-Repsold refractor at the Imperial Observatory, Strassburg, enabled Prof. Winnecke to observe this interesting comet as late as January 26, when unfavourable weather interfered, and he was not without the hope that it would be within reach after the next period of absence of moonlight. Even if this should not prove to have been the case, there will be more than fifteen weeks' observations available for the determination of the actual orbit of the comet, affording every reason to expect that its track in the heavens nearly eleven years hence, or at its next visible return, may be pretty closely predicted. The following positions are deduced from MM. Schulhof and Bossert's last elements:—

At Greenwich midnight

1881	R.A. h m s	Decl. ° ′	Log distance from Earth	Log distance from Sun
Feb. 14	6 42 20	+21 21·4	9·9007	0·2147
16	6 44 54	21 10·4	9·9158	0·2192
18	6 47 29	20 59·8	9·9307	0·2236
20	6 50 5	20 49·7	9·9454	0·2280
22	6 52 41	20 39·9	9·9600	0·2323
24	6 55 18	+20 30·4	9·9745	0·2366

Prof. Winnecke reports that the Merz-Repsold refractor is a great success; *Mimas* is an easy object, and it may be hoped that the observation of the nebulæ, to which it is understood the instrument is to be chiefly directed, may not prevent attention being given to the closest of Saturn's satellites.

THE PERSEIDS IN AUGUST, 1880.—M. Baillaud, Director of the Observatory of Toulouse, has published the results of the watch for meteors, maintained by three observers on the nights of August 9, 10, and 11 in the past year. 1172 shooting stars were observed, and 83 of the longest tracks were traced upon a chart; generally the tracks were very short, and their extremities pretty distant from the radiant. The meteors appeared to diverge from two points—the more numerous group from R.A. 42° 37′, Decl. 56° 39′, and a group of about one third the former, from R.A. 60° 39′, Decl. 62° 4′. The maximum occurred on August 10, between 14h. and 15h., in which interval 200 meteors were noted.

PHYSICAL NOTES

M. WIESNEGG has lately constructed for M. d'Arsonval a new steam-pressure regulator which deserves notice. It fulfils, according to the inventor, the following conditions:—(1) It maintains a perfectly constant pressure of steam in a boiler, whatever the actual output; (2) it maintains the consumption of fuel at a rate proportional to the output of steam; and (3) it is absolutely automatic, and therefore prevents all risks of explosion. This regulator is of very simple construction. A lead pipe from the boiler leads to a little apparatus somewhat resembling an ordinary lever safety-valve, but in which the valve-plug, instead of fitting into the usual conical seat, rests upon a thin disk of india-rubber. This disk rises when the pressure from below exceeds the downward pressure of the plug and the superincumbent lever, and of the weight which it carries. It cannot get hot, as it is far from the boiler, and the space below the disk is filled with water condensed from the steam. The upper surface of the valve-plug regulates by its movement the flow of gas, which comes in and goes out by two pipes leading to the upper part of the regulator. One of these comes from the gas mains, the other goes out to the burners under the boiler. By this arrangement, whenever the pressure in the boiler reaches any desired maximum, the apparatus itself reduces the supply and turns down the flame, thus maintaining the pressure constant and the consumption proportional to the output of vapour. It will be seen that the invention is only applicable to the case where the fuel employed is gas. The apparatus is also in itself an automatic safety valve, putting out the fire when the pressure exceeds the limit. M. Wiesnegg has had practical experience during three years of the working of the new regulator, which appears to leave nothing to be desired in its performance. The same gentleman has constructed a constant-pressure air-blast on the same principle.

PROF. CASSANI invites attention in the *Rivista Sci. Ind.* (November 30) to some singular phenomena of geometrical optics, thus indicated:—The real images, presented by a concave mirror or by a convergent lens, of a plane or spherical mirror, a lens or a prism, may by a suitable arrangement be made to appear like a real mirror, lens, or prism respectively. An observer stands opposite a concave mirror supported (with slight slant) at a distance greater than the radius of curvature, and receiving no other light than that reflected from his face (illuminated by a dark lantern). A small plane mirror placed in a position nearer the concave mirror than the observer, and sloping in opposite direction (it is concealed from his eye). The effect is that, on looking obliquely upwards, the observer seems to see a plane mirror (which is of larger size than the other) with his direct image in it. The illusion is the more complete if the actual plane mirror have an ornamental frame, and this be illuminated by a special lamp. As the image in the ideal mirror is always rather small and too near the mirror, this may arouse suspicion, the more so when the image is seen to diminish on receding and increase on advancing; but a person not familiar with the phenomena of concave mirrors may easily be deceived, thinking he sees a real mirror.

IN the *Proc. R.S.E.* Sir W. Thomson describes a thermo-magnetic thermoscope of an ingenious nature. It is well known that the "permanent" magnetism of steel magnets is not constant, but changes slightly with changes of temperature, the magnet becoming weaker when warmed, and recovering its strength as it is cooled. The magnetic thermoscope is intended to indicate differences of temperature by showing differences between the magnetic moments of steel magnets. Two thin wires of hard steel, each one centimetre long, are arranged so as to form a *nearly* astatic couple, being magnetised to equal strength and set in opposite directions, but not quite parallel, so that they set at right angles to the magnetic meridian. Two other magnets, about twice the size of the former pair, are placed one on each side of this astatic couple as "deflectors," being laid in one line nearly along the magnetic meridian, with their similar poles facing one another at about two centimetres apart. When properly adjusted the little astatic pair suspended between them will be found to be excessively sensitive to the least change in the strength of either of the deflectors, and if they are at different temperatures will turn through an angle which if small may be regarded as a measure of the temperature-difference. A small mirror suspended from the lower needle of the pair serves to reflect a spot of light on to a scale in the usual way.

IN 1870 and 1871 MM. Leverrier and Crova experimented with an optical telegraph between Nîmes and Redessan. Their system of signals were made by means of oil lamps or petroleum lamps fed by oxygen from a supply that could be turned on or off at will by an operator, who thus produced intermittent brilliant outbursts of flame according to a pre-arranged code. During December, 1880, a similar device was conceived by M. Mercadier, against whom M. Crova now reclaims the essential principles of his invention. He adds that two of the requisites of success lay in the use of oxygen under *very low pressure*, feeding the flame by an orifice in the midst of the flame, and in the employment of keys opening and shutting the gas-passages very suddenly by means of strong springs, without which the changes in the intensity of the flame go on too slowly to be comfortably observed. In the experiments of 1870-71 the lights at Nîmes were visible at Redessan and *vice versâ*, even in broad daylight. The oxygen supply was contained in ordinary gas bags of caoutchouc and prepared in the usual manner.

ONE of M Mercadier's recent experiments in radiophony deserves a note. A disk of thin copper about 4 centims in diameter, heated at its back by an oxyhydrogen blowpipe, was placed behind a rotating wheel with apertures, and the intermittent heat rays were received upon one of his sensitive disks of thin metal blackened at the surface With a bright red heat the customary note was well heard from the intermittent beams On putting out the flame the sound gradually fell off in intensity, but was still audible after the copper disk had ceased to emit visible rays All that this experiment proves, however, is that the dark rays, when they fall intermittently upon an absorbent surface, can cause it to undergo rapid expansions and contractions, while Graham Bell's earlier experiment showed that visible rays could produce this result.

M CORNU discusses in the *Comptes rendus* the propositions of M Gouy concerning the velocity of propagation of light proceeding from a source of variable amplitude, on which we lately published a note. He denies the truth of M. Gouy's fundamental assumptions, and concludes that since all our appliances can only change the amplitude of the waves by quantities which may be regarded as constant during a great many successive waves, the formula of waves of persistent type will still hold good, and the velocity of propagation of the amplitudes will be identical with that of the waves themselves

M CHAPPUIS thinks that the blue of the sky may be due to ozone present in the upper regions of the air He argues that the electrical discharges constantly taking place will produce ozone, and the recent researches of himself and M Hautefeuille have shown that ozone, at any rate when near its condensation point, is of a blue tint He has examined the absorption-spectrum of ozone and finds nine dark bands in it, three at least of which correspond with known bands in the telluric spectrum.

To obtain enlarged impressions from the phonograph, MM Roig and Torres (*Cronica cientifica*, No. 4) substitute for the metallic membrane which bears the indenting style a plate of mica, quite free at the border, and supported at the centre by an axis of caoutchouc fixed to a small spring This axis carries, besides the short style for acting on the tin sheet, a small metallic piece in a plane perpendicular to the axis of the style, and this supports a second style, long and thin, the vibrations of which are inscribed on a cylinder blackened with smoke The same angular velocity is imparted (by means of clockwork) to the cylinder of the phonograph and the blackened cylinder, and while the short style makes its usual marks on the tin, the long one produces a larger tracing on the cylinder, which the authors have tried to decipher. They have succeeded easily in recognising the different vowels, some consonants, and even some syllables, but they have not been able to read entire phrases. The curves are more characteristic if the voice be used with ordinary intensity, on forcing it they are deteriorated

PROF. AVENARIUS, of Kiew, has taken out an Austrian patent for a new method of division of the electric light The method is that of insertion of a polariser in a secondary circuit, connected with each electric lamp. The polariser, consists of several voltameters connected together. The current, supplied by an electrodynamic machine, divides before entering each lamp · one part goes through the lamp, while the second goes through the secondary circuit and the polariser and then back to the primary circuit By insertion of a considerable resistance, *e g* increase of the voltameters, the light-intensity of the lamps may be varied. The individual lamps are independent of each other, and lamps of different systems may be simultaneously used.

WE notice in the minutes of meetings of the Russian Physical and Chemical Society (vol xii fasc. 9) the researches, by M. Glasenap, on refraction. The want of concentricity of sheets of air of equal density produces a certain variation in the normal refraction given in the tables; the surfaces of equal density being as a rule inclined to some degree instead of being horizontal, and the degree of inclination being submitted to a certain periodicity during a whole year, there necessarily arises from this cause a certain correction to be applied to the observed position of a star, much like to that of the annual parallax and aberration, and which might be described as "parallax of refraction." As this correction must obviously affect the values of the annual parallax and of aberration, it is easy to understand the necessity to determine its true value with much accuracy. The values deduced by M. Glasenap for the stars ι of the Ursæ Majoris, ι and O Draconis, are −0″ 04, −0″·11, and −0″ 11, which figures would explain to a certain extent the negative parallaxes received by M Nyrén ("Nutation der Erdaxe"), and which respectively are −″ 03, −0″ 05, and −0″ 16 The whole work of M Glasenap on this subject will soon be published

CHEMICAL NOTES

THE influence of time on processes of chemical change has not yet been thoroughly investigated In a recent number of *Comptes rendus* Berthelot makes a contribution to this subject which is scarcely likely to be accepted by chemists without further investigation From the results of many thermo-chemical measurements Berthelot states that the chemical change, which occurs when an acid soluble in water acts on a soluble base or salt, or *vice versâ*, or when two soluble salts mutually react, is completed in a space of time not appreciably greater than that required for completely mixing the two solutions.

FROM experiments on the evolution of carbon dioxide from the roots of plants, detailed in the *Bull de la Soc botanique de France*, M. Cauvet concludes that carbon dioxide is certainly evolved from plant-roots, that the quantity evolved is less during night than during day, and that the quantity evolved increases at sunrise, decreases towards midday, and again increases in the evening.

HERR SALLERON describes in *Naturforscher* an instance of the modifying influence of moderately heated liquids on glass. An areometer used in a sugar-work lost about 0 5 grm. in weight after immersion for eight days in a sugar syrup at 95° The syrup contained 115 grm sugar and 91 grm ash per litre. After a few more days the glass split off in splinters

MR A A NESBIT has recently patented a very ingenious process for preventing fraudulent alterations of bankers' cheques Mr Nesbit prints his cheques with a dye or dyes, the colour of which is differently changed by acids and by alkalies, the inscriptions on the cheques are apparent by virtue of the alkalinity or acidity of the dye Immersion in dilute acid—for the purpose of dissolving out the written part of the cheque—causes the whole inscription to become acid tint; as subsequent treatment with alkali changes the whole inscription to alkaline tint, the original inscription cannot be restored If the acid part of the inscription be printed with a dye which is more strongly acid than the alkaline part is alkaline, treatment of the cheque with a neutral solvent of writing ink suffices to blur the inscription, and this blurring cannot be removed Various modifications of the invention, and details of the processes of printing, colours used, &c, are given in the specification.

M ÉTARD thinks that boron shows certain analogies with vanadium; in endeavouring further to illustrate such analogies he has obtained indications, although not yet positive proof, of the existence of an acid containing more oxygen than boric acid. He has also obtained, by the action of a saturated solution of boric acid on hydrated barium dioxide, a salt to which he gives the formula B_2O_4 BaO . $3H_2O$, and the name *barium perborate* This salt dissolves in acids with evolution of oxygen, it is very deliquescent (*Compt rend*)

IN continuation of his investigation into the compounds of sulphur and nitrogen M Demarçay describes (*Compt rend.*) various bodies which he regards as compounds of the radicle—$(S_4N_3)'$—called by him *thiotrazyl* The more important of the new compounds are formulated as $(S_4N_3)Cl$, $(S_4N_3)NO_3$, and $(S_4N_3)HSO_4$

LILBEN describes (in *Wien Akad Ber*) several compounds of calcium chloride with fatty acids, more especially the three compounds with butyric acid, viz —

$$CaCl_2\ C_4H_8O_2,\ CaCl_2\ 2C_4H_8O_2\ 2H_2O,\ \text{and}\ CaCl_2 . Ca(C_4H_7O_2)_2\ 4C_4H_8O_2.$$

M BYASSON states (*Compt. rend*) that if every trace of sulphurous acid be removed from chloral, the latter retains its liquid condition for an indefinite time, and that the change into solid metachloral, which soon takes place in chloral purified only by distillation, may be thus prevented To remove the last traces of sulphurous acid M Byasson agitates the chloral with $\frac{1}{100}$ of its weight of finely-powdered caustic baryta, decants the liquid, and distils

BERTHELOT has recently succeeded in isolating several compounds of metallic chlorides with hydrochloric acid; in *Compt. rend.* he describes three such chlorhydrates of metallic chlorides, viz. —

$CdCl_2 . 2HCl . 7H_2O$; $PbI_2 . HI . 5H_2O$; and $3AgI . HI . 7H_2O$;

and in another number of the same journal M. Ditté describes, among others, the salts $BiCl_3 . 3HCl$, $SbCl_3 . 3HCl$, &c. These hydrated salts are formed from their constituent compounds with a considerable evolution of heat, the amount varying from 11,000 to 15,000 units. The anhydrous salts readily undergo dissociation into their constituent compounds, and cannot therefore be readily obtained. Berthelot regards the formation and dissociation of these chlorhydrates as playing an important part in the mechanism of many chemical changes. Thus calomel is changed into corrosive sublimate and mercury by the action of hydrochloric acid: Berthelot would formulate this change as $Hg_2Cl_2 + xHCl = HgCl_2 . xHCl + Hg$ (attended with evolution of 9500 heat units), with subsequent dissociation of the chlorhydrate of $HgCl_2$. Again in the reduction of metallic chlorides by hydrogen Berthelot supposes that chlorhydrates are produced, and that the heat thus developed aids in dissociating fresh quantities of the original metallic chloride; thus he would indicate the initial stage of the reduction of cadmium chloride by hydrogen, as —

$$2CdCl_2 + H_2 = Cd + CdCl_2 . 2HCl.$$

M. WURTZ has recently been studying (*Compt. rend.*) the action of the ferment *Papain* on fibrin, whereby the fibrin is rendered soluble in water. The process appears to be analogous with many ordinary chemical changes in which the formation and decomposition of a compound are continually proceeding. Papain forms an insoluble compound with fibrin, which compound is then decomposed by the water present with formation of a soluble hydrated fibrin, and setting free of the ferment, which again acts on fresh quantities of fibrin.

IN the *American Chem. Journ.* Clarke and Stallo describe a series of experiments on the tartrates of antimony, wherein they are led to regard tartar emetic as the potassium salt of a new acid, to which they give the name *tartrantimonious*, viz. $Sb . C_4H_4O_6 . OH$. This acid they regard as derived from orthantimonious acid, $Sb(OH)_3$, which they have prepared in definite form. The behaviour of an aqueous solution of tartrantimonious acid towards heat is peculiar. Below 30° the solution remains nearly clear, at a few degrees above 30° a white curdy precipitate deposits; on evaporating in a water bath the curdy precipitate disappears and a transparent gummy mass remains, which is completely soluble in cold water, re forming the original acid. These changes are shown to be expressible by the equations—

1. $C_4H_5SbO_7 + 2H_2O = SbH_3O_3 + C_4H_6O_6$, the curdy precipitate consisting of orthantimonious acid.

2. $C_4H_6O_6 + SbH_3O_3 - 2H_2O + C_4H_5SbO_7$, *i.e.* on heating, water is eliminated, and the original acid is reproduced.

IN a series of papers in the *Berliner Berichte* Th. Thomsen endeavours to show that the "molecular rotation" of many classes of compounds is, for each class, a simple multiple of a constant number. "Molecular rotation" he defines as rotatory power $\times \frac{\text{molecular weight}}{100} \left(\frac{M\,(\alpha)_D}{100}\right)$. The constant for one group appears generally to bear a simple relation to that for other groups; in fact a constant may be found which belongs to many groups. Adopting a classification analogous to that of natural history, Thomsen shows that the constant 0.95 belongs to a large "class" of compounds, that this multiplied by 4 gives the constant (3.8) for the "family" of alcohols, and by 9 gives the constant (8.65) for the "family" of amides, &c. From a determination of the molecular rotation of compounds, aided by the use of these constants, he attempts also to deduce conclusions as to the chemical structure of the molecules of these compounds.

IN various papers noticed in this journal, Bruhl attempted to show that the "molecular refraction" $\left[M\left(\frac{\mu-1}{d}\right)\right]$ of isomeric carbon compounds is constant when only "singly-linked" carbon atoms are present, and that variations in this quantity are to be traced to variations in the "linking" of carbon atoms. Janowsky (*Berliner Berichte*) maintains that slight differences are always noticeable between the molecular refractions of isomeric compound where isomerism is due not to "linking," but to "grouping" of carbon atoms: but he thinks that if the values of the refractive indices of such compounds are considered, better results are obtained than by calculating the molecular refractions. Bruhl however had himself shown that the refraction indices of such isomers are not the same.

LANDOLT has gathered together in *Berliner Berichte* the more important data concerning the inversion of specific rotatory power of carbon compounds by the influence of heat or of inactive solvents: those data he supplements by further experiments of his own, and develops shortly the outlines of a mechanical theory analogous to that of Rammelsberg.

THE atomic weight of beryllium is still the subject of experiment. Emerson Reynolds has redetermined the specific heat of the pure metal (*Chem. News*) and obtained a number which points to 9.1 as the true atomic weight. The same value is assigned by Brauner, who (*Berliner Berichte*) criticises the arguments of Nilson and Pettersson, and attempts to show that the specific heat, specific volume, and general physical properties of beryllium oxide are more in keeping with the formula BeO (Be = 9·1) than with the formula Be_2O_3 (Be = 13.6) assigned to it by the Swedish observers.

IN a paper on bismuth compounds in *Chem. Soc. Journal*, by Muir, Hoffmeister, and Robbs, the new salts bismuth fluoride (BiF_3) and bismuth oxyfluoride (BiOF) are described. The former is the more stable of the halogen compounds of bismuth: it is not decomposed by water, and is scarcely changed at a red heat in air.

PROF. BEILSTEIN, who has recently studied the various substances used for disinfection, arrives, in a communication made to the St. Petersburg Technical Society, at the following conclusions:—Sulphuric acid would be the best disinfectant if it did not destroy the sides of the tanks; the use of lime and of salts of lime ought to be completely renounced, as they but temporarily destroy bacteria, and under some circumstances may contribute to their development; nor does sulphate of iron, even in a solution of 15 per cent., ultimately destroy bacteria, as they revive when put into a convenient medium. Therefore Prof. Beilstein recommends sulphate of aluminium, which is used in paper and printed-cotton manufactures. The best means for providing it is to make a mixture of red clay with 4 per cent. of sulphuric acid, and to add to this mixture some carbolic acid for destroying the smell of the matter which is to be disinfected.

ACTION OF AN INTERMITTENT BEAM OF RADIANT HEAT UPON GASEOUS MATTER[1]

THE Royal Society has already done me the honour of publishing a long series of memoirs on the interaction of radiant heat and gaseous matter. These memoirs did not escape criticism. Distinguished men, among whom the late Prof. Magnus and the late Prof. Buff may be more specially mentioned, examined my experiments, and arrived at results different from mine. Living workers of merit have also taken up the question, the latest of whom,[2] while justly recognising the extreme difficulty of the subject, and while verifying, so far as their experiments reach, what I had published regarding dry gases, find me to have fallen into what they consider grave errors in my treatment of vapours.

None of these investigators appear to me to have realised the true strength of my position in its relation to the objects I had in view. Occupied for the most part with details, they have failed to recognise the stringency of my work as a whole, and have not taken into account the independent support rendered by the various parts of the investigation to each other. They thus ignore verifications, both general and special, which are to me of conclusive force. Nevertheless, thinking it due to them and me to submit the questions at issue to a fresh examination, I resumed some time ago the threads of the inquiry. The results shall in due time be communicated to the Royal Society, but meanwhile I would ask permission to bring to the notice of the Fellows a novel mode of testing the relations of radiant heat to gaseous matter, whereby singularly instructive effects have been obtained.

After working for some time with the thermopile and galvano-

[1] Paper read at the Royal Society, January 13, by Prof. Tyndall, F.R.S.
[2] Lecher and Pernter, *Philosophical Magazine*, January, 1881; *Sitzb. der k. Akad. der Wissensch. in Wien*, July, 1880.

meter, it occurred to me several weeks ago that the results thus obtained might be checked by a more direct and simple form of experiment. Placing the gases and vapours in diathermanous bulbs, and exposing the bulbs to the action of radiant heat, the heat absorbed by different gases and vapours ought, I considered, to be rendered evident by ordinary expansion. I devised an apparatus with a view of testing this idea. But at this point, and before my proposed gas-thermometer was constructed, I became acquainted with the ingenious and original experiments of Mr. Graham Bell, wherein musical sounds are obtained through the action of an intermittent beam of light upon solid bodies.

From the first I entertained the opinion that these singular sounds were caused by rapid changes of temperature, producing corresponding changes of shape and volume in the bodies impinged upon by the beam. But if this be the case, and if gases and vapours really absorb radiant heat, they ought to produce sounds more intense than those obtainable from solids. I pictured every stroke of the beam responded to by a sudden expansion of the absorbent gas, and concluded that when the pulses thus excited followed each other with sufficient rapidity, a musical note must be the result. It seemed plain, moreover, that by this new method many of my previous results might be brought to an independent test. Highly diathermanous bodies, I reasoned, would produce faint sounds, while highly athermanous bodies would produce loud sounds, the strength of the sound being, in a sense, a measure of the absorption. The first experiment made with a view of testing this idea, was executed in the presence of Mr Graham Bell[1], and the result was in exact accordance with what I had foreseen.

The inquiry has been recently extended so as to embrace most of the gases and vapours employed in my former researches. My first source of rays was a Siemens' lamp connected with a dynamo-machine, worked by a gas-engine. A glass lens was used to concentrate the rays, and afterwards two lenses. By the first the rays were rendered parallel, while the second caused them to converge to a point about seven inches distant from the lens. A circle of sheet zinc provided first with radial slits and afterwards with teeth and interspaces cut through it, was mounted vertically on a whirling table, and caused to rotate rapidly across the beam near the focus. The passage of the slits produced the desired intermittence,[2] while a flask containing the gas or vapour to be examined received the shocks of the beam immediately behind the rotating disk. From the flask a tube of india-rubber, ending in a tapering one of ivory or boxwood, led to the ear, which was thus rendered keenly sensitive to any sound generated within the flask. Compared with the beautiful apparatus of Mr. Graham Bell, the arrangement here described is rude; it is, however, very effective.

With this arrangement the number of sounding gases and vapours was rapidly increased. But I was soon made aware that the glass lenses withdrew from the beam its most effectual rays. The silvered mirrors employed in my previous researches were therefore invoked, and with them, acting sometimes singly and sometimes as conjugate mirrors, the curious and striking results which I have now the honour to submit to the Society were obtained.

Sulphuric ether, formic ether, and acetic ether being placed in bulbous flasks, their vapours were soon diffused in the air above the liquid. On placing these flasks, whose bottoms only were covered by the liquid, behind the rotating disk, so that the intermittent beam passed through the vapour, loud musical tones were in each case obtained. These are known to be the most highly absorbent vapours which my experiments revealed. Chloroform and bisulphide of carbon, on the other hand, are known to be the least absorbent, the latter standing near the head of diathermanous vapours. The sounds extracted from these two substances were usually weak and sometimes barely audible, being more feeble with the bisulphide than with the chloroform. With regard to the vapours of amylene, iodide of ethyl, iodide of methyl and benzol, other things being equal, their power to produce musical tones appeared to be accurately expressed by their ability to absorb radiant heat.

It is the vapour, and not the liquid, that is effective in producing the sounds. Taking, for example, the bottles in which my volatile substances are habitually kept, I permitted the intermittent beam to impinge upon the liquid in each of them. No sound was in any case produced, while the moment the vapour-laden space above an active liquid was traversed by the beam, musical tones made themselves audible.

A rock-salt cell filled entirely with a volatile liquid and subjected to the intermittent beam produced no sound. This cell was circular and closed at the top. Once, while operating with a highly athermanous substance, a distinct musical note was heard. On examining the cell however a small bubble was found at its top. The bubble was less than a quarter of an inch in diameter, but still sufficient to produce audible sounds. When the cell was completely filled the sounds disappeared.

It is hardly necessary to state that the pitch of the note obtained in each case is determined by the velocity of rotation. It is the same as that produced by blowing against the rotating disk and allowing its slits to act like the perforations of a syren.

Thus, as regards vapours, prevision has been justified by experiment. I now turn to gases. A small flask, after having been heated in the spirit-lamp so as to detach all moisture from its sides, was carefully filled with dried air. Placed in the intermittent beam it yielded a musical note, but so feeble as to be heard only with attention. Dry oxygen and hydrogen behaved like dry air. This agrees with my former experiments, which assigned a hardly sensible absorption to these gases. When the dry air was displaced by carbonic acid, the sound was far louder than that obtained from any of the elementary gases. When the carbonic acid was displaced by nitrous oxide the sound was much more forcible still, and when the nitrous oxide was displaced by olefiant gas it gave birth to a musical note which, when the beam was in good condition and the bulb well chosen, seemed as loud as that of an ordinary organ-pipe. We have here the exact order in which my former experiments proved these gases to stand as absorbers of radiant heat. The amount of the absorption and the intensity of the sound go hand in hand.

In 1859 I proved gaseous ammonia to be extremely impervious to radiant heat. My interest in its deportment when subjected to this novel test was therefore great. Placing a small quantity of liquid ammonia in one of the flasks, and warming the liquid slightly, the intermittent beam was sent through the space above the liquid. A loud musical note was immediately produced. By the proper application of heat to a liquid the sounds may be always intensified. The ordinary temperature however suffices in all the cases thus far referred to.

In this relation the vapour of water was that which interested me most, and as I could not hope that at ordinary temperatures it existed in sufficient amount to produce audible tones, I heated a small quantity of water in a flask almost up to its boiling-point. Placed in the intermittent beam, I heard—I avow with delight—a powerful musical sound produced by the aqueous vapour.

Small wreaths of haze, produced by the partial condensation of the vapour in the upper and cooler air of the flask, were however visible in this experiment, and it was necessary to prove that this haze was not the cause of the sound. The flask was therefore heated by a spirit-flame beyond the temperature of boiling water. The closest scrutiny by a condensed beam of light then revealed no trace of cloudiness above the liquid. From the perfectly invisible vapour however the musical sound issued, if anything, more forcible than before. I placed the flask in cold water until its temperature was reduced from about 90° to 10° C, fully expecting that the sound would vanish at this temperature, but notwithstanding the tenuity of the vapour, the sound extracted from it was not only distinct but loud.

Three empty flasks filled with ordinary air were placed in a freezing mixture for a quarter of an hour. On being rapidly transferred to the intermittent beam, sounds much louder than those obtainable from dry air were produced.

Warming these flasks in the flame of a spirit-lamp until all visible humidity had been removed, and afterwards urging dried air through them, on being placed in the intermittent beam the sound in each case was found to have fallen almost to silence.

Sending, by means of a glass tube, a puff of breath from the lungs into a dried flask, the power of emitting sound was immediately restored.

[1] On November 29. see *Journal* of the Society of Telegraph Engineers, December 8, 1880.

[2] When the disk rotates the individual slits disappear, forming a hazy zone through which objects are visible. Throwing by the clean hand, or better still by white paper, the beam back upon the disk, it appears to stand still, the slits forming so many dark rectangles. The reason is obvious, but the experiment is a very beautiful one.

I may add that when I stand with open eyes in the flashing beam, at a definite velocity of recurrence, subjective colours of extraordinary gorgeousness are produced. With slower or quicker rates of rotation the colours disappear. The flashes also produce a giddiness sometimes intense enough to cause me to grasp the table to keep myself erect.

When, instead of breathing into a dry flask, the common air of the laboratory was urged through it, the sounds became immediately intensified. I was by no means prepared for the extraordinary delicacy of this new method of testing the athermancy and diathermancy of gases and vapours, and it cannot be otherwise than satisfactory to me to find that particular vapour, whose alleged deportment towards radiant heat has been most strenuously denied, affirming thus audibly its true character.

After what has been stated regarding aqueous vapour we are prepared for the fact that an exceedingly small percentage of any highly athermanous gas diffused in air suffices to exalt the sounds. An accidental observation will illustrate this point. A flask was filled with coal gas and held bottom upwards in the intermittent beam. The sounds produced were of a force corresponding to the known absorptive energy of coal-gas. The flask was then placed upright, with its mouth open upon a table, and permitted to remain there for nearly an hour. On being restored to the beam, the sounds produced were far louder than those which could be obtained from common air.[1]

Transferring a small flask or a test-tube from a cold place to the intermittent beam it is sometimes found to be practically silent for a moment, after which the sounds become distinctly audible. This I take to be due to the vaporisation by the calorific beam of the thin film of moisture adherent to the glass.

My previous experiments having satisfied me of the generality of the rule that volatile liquids and their vapours absorb the same rays, I thought it probable that the introduction of a thin layer of its liquid, even in the case of a most energetic vapour, would detach the effective rays, and thus quench the sounds. The experiment was made and the conclusion verified. A layer of water, formic ether, sulphuric ether, or acetic ether one-eighth of an inch in thickness rendered the transmitted beam powerless to produce any musical sound. These liquids being transparent to light, the efficient rays which they intercepted must have been those of obscure heat.

A layer of bisulphide of carbon about ten times the thickness of the transparent layers just referred to, and rendered opaque to light by dissolved iodine, was interposed in the path of the intermittent beam. It produced hardly any diminution of the sounds of the more active vapours—a further proof that it is the invisible heat rays, to which the solution of iodine is so eminently transparent, that are here effectual.

Converting one of the small flasks used in the foregoing experiments into a thermometer bulb, and filling it with various gases in succession, it was found that with those gases which yielded a feeble sound, the displacement of a thermometric column associated with the bulb was slow and feeble, while with those gases which yielded loud sounds the displacement was prompt and forcible.

Further Experiments.—Since the handing in of the foregoing note, on January 3, the experiments have been pushed forward, augmented acquaintance with the subject serving only to confirm my estimate of its interest and importance.

All the results described in my first note have been obtained in a very energetic form with a battery of sixty Grove's cells.

On January 4 I chose for my source of rays a powerful lime-light, which, when sufficient care is taken to prevent the pitting of the cylinder, works with admirable steadiness and without any noise. I also changed my mirror for one of shorter focus, which permitted a nearer approach to the source of rays. Tested with this new reflector the stronger vapours rose remarkably in sounding power.

Improved manipulation was, I considered, sure to extract sounds from rays of much more moderate intensity than those of the lime-light. For this light, therefore, a common candle flame was substituted. Received and thrown back by the mirror, the radiant heat of the candle produced audible tones in all the stronger vapours.

Abandoning the mirror and bringing the candle close to the rotating disk, its direct rays produced audible sounds.

A red-hot coal, taken from the fire and held close to the rotating disk, produced forcible sounds in a flask at the other side.

A red-hot poker, placed in the position previously occupied by the coal, produced strong sounds. Maintaining the flask in position behind the rotating disk, amusing alternations of sound and silence accompanied the alternate introduction and removal of the poker.

[1] The method here described is, I doubt not, applicable to the detection of extremely small quantities of fire-damp in mines.

The temperature of the iron was then lowered till its heat just ceased to be visible. The intermittent invisible rays produced audible sounds.

The temperature was gradually lowered, being accompanied by a gradual and continuous diminution of the sound. When it ceased to be audible the temperature of the poker was found to be below that of boiling water.

As might be expected from the foregoing experiments an incandescent platinum spiral, with or without the mirror, produced musical sounds. When the battery power was reduced from ten cells to three the sounds, though enfeebled, were still distinct.

My neglect of aqueous vapour had led me for a time astray in 1859, but before publishing my results I had discovered my error. On the present occasion this omnipresent substance had also to be reckoned with. Fourteen flasks of various sizes, with their bottoms covered with a little sulphuric acid, were closed with ordinary corks and permitted to remain in the laboratory from December 23 to January 4. Tested on the latter day with the intermittent beam, half of them emitted feeble sounds, but half were silent. The sounds were undoubtedly due, not to dry air, but to traces of aqueous vapour.

An ordinary bottle containing sulphuric acid for laboratory purposes, being connected with the ear and placed in the intermittent beam, emitted a faint, but distinct, musical sound. This bottle had been opened two or three times during the day, its dryness being thus vitiated by the mixture of a small quantity of common air. A second similar bottle, in which sulphuric acid had stood undisturbed for some days, was placed in the beam: the dry air above the liquid proved absolutely silent.

On the evening of January 7 Prof. Dewar handed me four flasks treated in the following manner:—Into one was poured a small quantity of strong sulphuric acid; into another a small quantity of Nordhausen sulphuric acid; in a third were placed some fragments of fused chloride of calcium; while the fourth contained a small quantity of phosphoric anhydride. They were closed with well-fitting india-rubber stoppers, and permitted to remain undisturbed throughout the night. Tested after twelve hours, each of them emitted a feeble sound, the flask last-mentioned being the strongest. Tested again six hours later, the sound had disappeared from three of the flasks, that containing the phosphoric anhydride alone remaining musical.

Breathing into a flask partially filled with sulphuric acid instantly restores the sounding power, which continues for a considerable time. The wetting of the interior surface of the flask with the sulphuric acid always enfeebles, and sometimes destroys, the sound.

A bulb less than a cubic inch in volume, and containing a little water lowered to the temperature of melting ice, produces very distinct sounds. Warming the water in the flame of a spirit-lamp, the sound becomes greatly augmented in strength. At the boiling temperature the sound emitted by this small bulb[1] is of extraordinary intensity.

These results are in accord with those obtained by me nearly nineteen years ago, both in reference to air and to aqueous vapour. They are in utter disaccord with those obtained by other experimenters, who have ascribed a high absorption to air and none to aqueous vapour.

The action of aqueous vapour being thus revealed, the necessity of thoroughly drying the flasks when testing other substances becomes obvious. The following plan has been found effective:—Each flask is first heated in the flame of a spirit-lamp till every visible trace of internal moisture has disappeared, and it is afterwards raised to a temperature of about 400° C. While the glass is still hot a glass tube is introduced into it, and air freed from carbonic acid by caustic potash, and from aqueous vapour by sulphuric acid, is urged through the flask until it is cool. Connected with the ear-tube, and exposed immediately to the intermittent beam, the attention of the ear, if I may use the term, is converged upon the flask. When the experiment is carefully made, dry air proves as incompetent to produce sound as to absorb radiant heat.

In 1868 I determined the absorptions of a great number of liquids whose vapours I did not examine. My experiments having amply proved the parallelism of liquid and vaporous absorption, I held undoubtingly twelve years ago that the vapour of cyanide of ethyl and of acetic acid would prove powerfully absorbent. This conclusion is now easily tested. A small

[1] In such bulbs even bisulphide of carbon vapour may be so nursed as to produce sounds of considerable strength.

quantity of either of these substances, placed in a bulb a cubic inch in volume, warmed, and exposed to the intermittent beam, emits a sound of extraordinary power

I also tried to extract sounds from perfumes, which I had proved in 1861 to be absorbers of radiant heat I limit myself here to the vapours of pachouli and cassia, the former exercising a measured absorption of 30, and the latter an absorption of 109 Placed in dried flasks, and slightly warmed, sounds were obtained from both these substances, but the sound of cassia was much louder than that of pachouli

Many years ago I had proved tetrachloride of carbon to be highly diathermanous Its sounding power is as feeble as its absorbent power

In relation to colliery explosions, the deportment of marsh-gas was of special interest Prof Dewar was good enough to furnish me with a pure sample of this gas. The sounds produced by it, when exposed to the intermittent beam, were very powerful.

Chloride of methyl, a liquid which boils at the ordinary temperature of the air, was poured into a small flask, and permitted to displace the air within it Exposed to the intermittent beam, its sound was similar in power to that of marsh-gas

The specific gravity of marsh-gas being about half that of air, it might be expected that the flask containing it, when left open and erect, would soon get rid of its contents This however is not the case. After a considerable interval the film of this gas clinging to the interior surface of the flask was able to produce sounds of great power

A small quantity of liquid bromine being poured into a well-dried flask, the brown vapour rapidly diffused itself in the air above the liquid. Placed in the intermittent beam, a somewhat forcible sound was produced This might seem to militate against my former experiments, which assigned a very low absorptive power to bromine vapour But my former experiments on this vapour were conducted with obscure heat, whereas in the present instance I had to deal with the radiation from incandescent lime, whose heat is in part luminous Now the colour of the bromine vapour proves it to be an energetic absorber of the luminous rays, and to them, when suddenly converted into thermometric heat in the body of the vapour, I thought the sounds might be due

Between the flask containing the bromine and the rotating disk I therefore placed an empty glass cell the sounds continued I then filled the cell with transparent bisulphide of carbon the sounds still continued For the transparent bisulphide I then substituted the same liquid saturated with dissolved iodine This solution cut off the light, while allowing the rays of heat free transmission the sounds were immediately stilled

Iodine vaporised by heat in a small flask yielded a forcible sound, which was not sensibly affected by the interposition of transparent bisulphide of carbon, but which was completely quelled by the iodine solution It might indeed have been foreseen that the rays transmitted by the iodine as a liquid would also be transmitted by its vapour, and thus fail to be converted into sound [1]

To complete the argument.—While the flask containing the bromine vapour was sounding in the intermittent beam, a strong solution of alum was interposed between it and the rotating disk There was no sensible abatement of the sounds with either bromine or iodine vapour

In these experiments the rays from the lime-light were converged to a point a little beyond the rotating disk. In the next experiment they were rendered parallel by the mirror, and afterwards rendered convergent by a lens of ice At the focus of the ice-lens the sounds were extracted from both bromine and iodine vapour. Sounds were also produced after the beam had been sent through the alum solution and the ice-lens conjointly.

With a very rude arrangement I have been able to hear the sounds of the more active vapours at a distance of 100 feet from the source of rays.

Several vapours other than those mentioned in this abstract have been examined, and sounds obtained from all of them The vapours of all compound liquids will, I doubt not, be found sonorous in the intermittent beam. And, as I question whether there is an absolutely diathermanous substance in nature, I think it probable that even the vapours of elementary bodies, including the elementary gases, when more strictly examined, will be found capable of producing sounds.

[1] I intentionally use this phraseology

INTERESTING NEW CRINOIDS

IN the *Memoirs* of the Swiss Palæontological Society for 1880 Prof P de Loriol has recently described a remarkable new Crinoid which he refers to the little known genus *Thiollericrinus*, Etallon, under the name of *T. [illegible]* It occurs in the Upper Jurassic beds of Engenheiro, in Portugal. The calyx, like that of most Jurassic *Comatulæ*, has five small prismatic basals attached to the under surface of the radials. But the centro-dorsal piece on which the calyx rests is not entirely separated from the lower part of the stem, as is the case in the *Comatulæ*, though it resembles that of a *Comatula* in bearing cirrhi

Thiollericrinus was a stalked Crinoid that never developed beyond the stage at which cirrhi appear on the enlarged uppermost stem joint of the stalked larva of *Comatula* The under-face of the centrodorsal and the terminal faces of the other stem joints resemble those of the *Comatula* larva and also of *Bourgueticrinus* and *Rhizocrinus* in their oval shape and in the presence of transverse ridges which are in different planes at the two ends of each joint *Thiollericrinus* therefore is a permanent larval form, and furnishes an intermediate stage between the stalked *Bourgueticrinus* and the free *Comatula* The top stem-joint of the former bears no cirrhi, as it does in *Thiollericrinus* and in *Comatula*, while in the latter it develops cirrhi, and unites closely with the calyx, separating from the rest of the larval stem on which it was previously fixed.

Another form of considerable morphological interest, from its occupying an intermediate position between two well defined genera, has been lately described by Mr P H Carpenter under the name of *Mesocrinus* The stem-joints are of the type already mentioned as characteristic of *Bourgueticrinus*, having oval faces marked by transverse ridges in different planes But the upper stem-joint is not enlarged as it is in *Bourgueticrinus* and in the *Apiocrinidæ* generally, while the form of the calyx recalls that of the *Pentacrinidæ* It consists of five radials with well-developed articular faces, resting on five basals which form a complete ring as in the recent *Pentacrinus Wyville-Thomsoni*, from 800 fathoms in the Atlantic off the coast of Portugal

Broadly speaking, therefore, *Mesocrinus* combines the stem of *Bourgueticrinus* with the calyx of *Pentacrinus*, or rather of *Cainocrinus*, as Prof. de Loriol prefers to call that section of the *Pentacrinus* type in which the basal ring is closed. *Mesocrinus* is an Upper Cretaceous genus, one species occurring in the "Plänerkalk" of Strehlen in Saxony, while another and larger one was found in the "Mucronaten Kreide" of Southern Sweden

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—In consequence of the unsatisfactory state of many of the lodging-houses in Oxford, in respect of their sanitary arrangements, a proposal will be brought before Congregation on March 1 "to make better provision for the supervision of lodging-houses" One of the delegates for licensing lodgings will be stipendiary, and it will be his duty to inspect every dwelling house proposed for this use and to satisfy himself of its sanitary fitness. He shall have the assistance of a sanitary inspector, and shall have proctorial authority over members of the University in his character of inspector.

A special statute will also be proposed authorising the present delegates of lodging houses to spend whatever sum they may think necessary on a general inspection of lodging houses during the present year

There will be holden at Christ Church on Saturday, March 12, an election to at least one Mathematical Junior Studentship, and at least one in Natural Science, tenable for five years from the day of election. They will be of the annual value either (1) of 100*l* (including an allowance for room rent) if the Governing Body shall so determine, or (2) of 85*l* (also including an allowance for room rent), which may be raised to the larger sum above named after the completion of one year's residence, if the Governing Body shall so determine Candidates for the Mathematical Studentships and candidates for the Natural Science Studentships who offer mathematics will call upon the Dean on Monday, February 28, between 12 30 and 1 30 p m.; candidates for the Natural Science Studentships who do not offer mathematics, on March 2, between 12.30 and 1 30 p m. All must produce certificates both of the day of their birth and of good character. The examinations will follow in each case at

2 p.m. Candidates for either the Classical or the Mathematical Studentships must not have exceeded the age of nineteen on January 1, 1881; candidates for the Natural Science Studentships must not have exceeded the age of twenty on the same day.

CAMBRIDGE.—There was a meeting of the members of the Senate on February 11, for the purpose of discussing the report of the Syndicate appointed last June to consider certain memorials as to the higher education of women. The Syndicate recommend that, subject to certain conditions of residence at Girton and Newnham Colleges, female students may be admitted to the Tripos Examinations, and certificates issued to them as to the result of the examination.—The Master of Emmanuel, in opening the discussion, remarked that he had never sat on any Syndicate before where so little difficulty had been experienced in agreeing to a report. Personally he wished the Syndicate had arrived at a different conclusion, and had recommended the admission of women to all the University examinations. He claimed for the recommendations of the Syndicate, however, that they closely followed the views of an influential number of residents who had signed a memorial on the subject, and wished for an official sanction to that which had been done for ten years without authority. He contended that it was the imperative duty of the University to give all possible access to its educational advantages, and that the proposed scheme was only a step in that direction.—Dr. Campion contended that the public opinion of the University had been carefully excluded in the constitution of the Syndicate. He charged the report with being both illiberal and harsh. It was illiberal, because the Syndicate had restricted the examinations to inmates of particular colleges, and was not for the encouragement of the higher education of women all over the country. Why was the advantage given only to Newnham and Girton Colleges? The report was harsh, for when they admitted women to test their scientific powers, it was unfair to do so after the conclusion of a time race with the men. Why not let the women study as long as they liked? He did not object to their being compelled to pass the previous examination, but to compel them to go step by step with undergraduates was placing them, by reason of their defect of physical power, in a false position.—Prof. Kennedy said, it was proposed to limit the competition to those within their reach; if the experiment succeeded, it would be a matter for future consideration what extensions should be made. As to the harshness, that surely might be left to the better judgment of the friends, relations, and guardians of these women who asked for these concessions. Women were mentally men's equals, but physically not. To urge their want of physical power as an objection to their admission to the same intellectual pursuits and pleasures as men was more for the Brahmin than the believer in the Bible; it was a fitter argument for the Turk than the Saxon.—Prof. Liveing defended the Syndicate from the attack of Dr. Campion, and asserted that the matter was discussed fully and fairly, without any bias of previously formed opinions.—Prof. Westcott, who did not concur in the whole of the report, expressed his great regret that the Syndicate before reporting had not collected further information on a problem so difficult and obscure.—Mr. Prothero, King's, was of opinion that the same course of training which was good for male students was equally good for women.—Mr. Sidgwick, Trinity, drew attention to the remarkable fact that no objection had been raised to the main proposal of the Syndicate.—The discussion lasted upwards of two hours.

KIEFF.—The number of students at the University of Kieff was, on January 1, 1881, as much as 1041, with fifty-eight professors.

SCIENTIFIC SERIALS

THE *Quarterly Journal of Microscopical Science* for January contains notes on a peculiar form of Polyzoa closely allied to Bugula (Kinetoskias, Kor. and Dan.), by George Busk, F.R.S., with plates 1 and 2.—On the germination and histology of the seedling of *Welwitschia mirabilis*, by F. Orpen Bower, B.A., with plates 3 and 4.—Notes on some of the Reticularian Rhizopoda of the *Challenger*, by Henry B. Brady, F.R.S.—On the head-cavities and associated nerves of Elasmobranchs, by Prof. A. M. Marshall, M.A., with plates 5 and 6.—Contributions to the minute anatomy of the nasal mucous membrane, by Dr. E. Klein, F.R.S., with plate 7.—Histological notes, by Dr. E. Klein, F.R.S.—On the intra-cellular digestion and endoderm of Limnocodium, by E. R. Lankester, M.A., F.R.S., with plates 8 to 10.—On the micrometric numeration of the blood-corpuscles, and the estimation of their hæmoglobin, by Mrs. Ernest Hart.—Preliminary account of the development of the lampreys, by W. B. Scott, M.A.—On some appearances of the red blood-corpuscles of men and other vertebrata, by G. F. Dowdeswell, B.A.

THE *Journal of Anatomy and Physiology, Normal and Pathological*, vol. xv., part 2, January, 1881, contains—Dr. John Struthers, the bones, articulations, and muscles of the rudimentary hind-limb of the Greenland right-whale (*Balæna mysticetus*), (with four plates).—Dr. Creighton, on an infective form of tuberculosis in man identical with bovine tuberculosis.—Dr. W. Osler, medullary neuroma of the brain (plate 18).—A. Doran, case of fissure of the abdominal walls (plate 19).—Dr. D. Newman, description of a polygraph (with woodcut).—Dr. O. H. Jones, on the mechanism of the secretion of sweat.—Dr. P. S. Abraham, anomalous pilose growth in the pharynx of a woman (woodcut).—Dr. R. Saundby, histology of granular kidney (woodcut).—Dr. J. Oliver, two cases of cerebellar disease.—Prof. M'Kendrick, on the colouring-matter of jelly-fishes.—Dr. Cunningham, nerves of hind-limb of the Thylacine and Cuscus.—Dr. W. J. Fleming, pulse dicrotism.

THE *American Naturalist* for January, 1881, contains Prof. A. Geikie, the ancient glaciers of the Rocky Mountains.—Fred. W. Simonds, the discovery of iron implements in an ancient mine in North Carolina.—William Trelease, on the fertilisation of *Calamintha nepeta* (woodcuts).—S. V. Clevenger, comparative neurology.—E. L. Greene, botanising on the Colorado desert.—W. J. Beal, on a method of distinguishing species of poplars and walnuts by their young leafless branches (woodcuts).—James L. Lippincott, an address to the fossil bones in a private museum.—The Editor's table: Recent Literature.—General Notes [this portion of the journal has been very considerably enlarged with this number. The Botanical, Zoological, Entomological, Anthropological, Geological, Geographical, and Microscopical Sections are each under the charge of a special editor as formerly].—Scientific News.—Proceedings of Scientific Societies.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, January 27.—"The Refraction Equivalents of Carbon, Hydrogen, Oxygen, and Nitrogen in Organic Compounds." By J. H. Gladstone, Ph.D., F.R.S.

Since the communication which I had the honour to read before this Society in 1869, "On the Refraction Equivalents of the Elements," very little has been done on the subject.

Of late however its importance in regard to theories of chemical structure has been recognised by Dr. Thorpe and other chemists in this country, and attention has been recalled to it in Germany by the papers of Brühl, who, following closely in the footsteps of Landolt, has endeavoured to explain the results in the language of modern organic chemistry.

At this juncture it may be of service to put on record my present views in regard to the refraction equivalents of the four principal constituents of organic bodies—carbon, hydrogen, oxygen, and nitrogen.

Carbon.—Carbon in its compounds has at least three equivalents of refraction, 5.0, 6.0, or 6.1, and about 8.8.

Whether its refraction should be one or other of these appears to depend on the way in which the atoms are combined.

When a single carbon atom has each of its four units of atomicity satisfied by some other element, it has a value not exceeding 5.0.

When a carbon atom has one of its units of atomicity satisfied by another carbon atom and the remainder by some other element, it has the value of 5.0. This is also the case if two of its units of atomicity are satisfied by carbon atoms.

When a carbon atom has three of its units of atomicity satisfied by other carbon atoms, its value is 6.0. The most striking instance is that of benzol, C_6H_6 (refraction equivalent 43.7).

There are other organic compounds in which only some of the atoms of carbon have the higher value. It has been especially the work of Brühl to point this out, and to show that where they occur (as in amylene or the allyl compounds) the carbon atom is in a condition similar to those in the phenyl nucleus, that condition in fact which is generally represented in our

graphic formulæ by two carbon atoms linked by double bonds The value assigned by Bruhl in such cases is however 6·1 This somewhat higher figure is deduced from the aggregate value of the six carbon atoms in the nucleus of the aromatic series, which (except in benzol and its simpler substitution products) would appear to be nearer 37 than 36 The fact however is susceptible of another interpretation The replacement of hydrogen by some nomad radicle is an important change, and if that radicle be CH_3 it is evident that according to present views the carbon atom must have all four of its units of atomicity satisfied with carbon, and by analogy we should expect it to have its refraction increased

When a carbon atom has all four of its units of atomicity satisfied by other carbon atoms, each of which has the higher value of 6·0 or 6·1, its equivalent of refraction is greatly raised There are compounds in which the atoms of carbon actually out-number the atoms of hydrogen or its substitute, such as naphthalene, $C_{10}H_8$ (ref. eq 75 1), naphthol, $C_{10}H_8O$ (79 5), phenanthrene, $C_{14}H_{10}$ (108 3), and pyrene, $C_{16}H_{10}$ (126 1). That the refraction is greatly raised is evident from the fact that, if we were to reckon all the carbon atoms at 6 1, the refraction equivalent of the body would not be fully accounted for. It is evident that in pyrene only ten of the atoms of carbon can be in the same condition as they are in benzol or styrol, the other six must have all their units of atomicity satisfied by carbon alone Provisionally I venture to assign 8 8 as the refraction equivalent of this highest carbon.

There are several other bodies, such as anthracene, anethol, furfurol, and hydride of cinnamyl, which from their abnormally high refraction appear to contain carbon in this last condition

Hydrogen —The general evidence with regard to hydrogen in organic compounds tends to show that it has only one refraction equivalent, that originally assigned to it by Landolt, 1 3

Oxygen —Bruhl has been the first to point out that oxygen in organic compounds has two values, and he comes to the conclusion that it has the value 3 4 where the oxygen is attached to a carbon atom by a double linking, but 2 8 in hydroxyl and where the oxygen is united to two other atoms. This is deduced from experimental data. But there are other results which present difficulties, such as the various alcohols

Nitrogen.—Nitrogen has two values, 4 1 and 5 1, or thereabouts

The lower value, 4·1, is that originally deduced from cyanogen and metallic cyanides, and it seems to be generally confirmed by the observations on organic cyanides and nitriles. The higher value, 5·1, is deduced from observations on organic bases and amides

I hope shortly to submit to the public the whole of the data for these conclusions.

February 3—"On the Influence of Temperature on the Musical Pitch of Harmonium Reeds" By Alex J Ellis, F.R.S

The writer gave a tabular account of the experiments on the harmonium reeds of Appunn's treble tonometer at South Kensington Museum, at temperatures differing by from 20° to 26° F, which rendered it probable that the pitch of such reeds was affected by temperature to twice the extent of tuning-forks and in the same direction, that is, that they flattened by heat and sharpened by cold about 1 in 10,000 vibrations in a second for each degree Fahrenheit.

"On an Improved Bimodular Method of computing Natural and Tabular Logarithms and Anti-Logarithms to Twelve or Sixteen Places, with very brief Tables." By Alex J Ellis, F.R S.

A bimodular method is one founded on the familiar proposition, that if the bimodulus (that is, twice the modulus of any system of logarithms) be multiplied by the difference and divided by the sum of two numbers, the result would be approximatively the difference of their logarithms. The improvement consisted in a simple preparation of a given number to make it lie between two numbers in a given table of interpolation, consisting of 100 entries, and in then determining how many places might be trusted without correction, and in correcting the result by a short table so as to give twelve places at sight and sixteen places by means of ordinary table of seven figure logarithms. The antilogarithms were found by first depriving a logarithm of its correction, and then dividing the result added to the bimodulus by the result subtracted from the bimodulus—an entirely new rule Complete tables and worked out examples fully explained were added.

"On the Potential Radix as a Means of Calculating Logarithms to any Required Number of Decimal Places, with a Summary of all Preceding Methods Chronologically Arranged," by Alexander J. Ellis, F.R S

A positive numerical radix consists of the numbers r, $1 + 0_m r$, and their logarithms, where r varies from 1 to 9, 0_m means a series of m successive zeros, and m varies from 1 to any required number. The term "radix" is due to Robert Flower (1771) and is preserved *in memoriam*. It was shown that such a table would enable any logarithm to be calculated by the improved bimodular method and other methods. A negative numerical radix consists of the numbers $1 - 0_m r$, and their negative logarithms, and it was shown that such a table would serve the same purpose somewhat more easily Hence the whole process is reduced to the construction of such radixes A chronological summary was then given of all preceding methods, showing that most of them depended on having such radixes The construction of a numerical radix is however a very long and troublesome process by the methods ordinarily used For this purpose the potential radix for natural logarithms was first constructed, consisting of 10^r, 2^r, $(1\ 1)^r$, and $(1\ 0_m\ 1)^r$, negative $(1 - 0_m 1)^r$, from $r = 1$ to $r = 10$ (the latter terms being calculated by simple addition), and their natural logarithms, first to any number of places from the very simple series for nat log $(1 \pm {}^{\cdot}0_m r)$, and secondly, by simple addition This gives a radix from which natural logarithms of all numbers can be calculated to any number of places by the improved bimodular method But the main use of the potential radix is to calculate the nat logs. of the numbers of the numerical radix The radix for tabular logarithms is then found by multiplying by the modulus, already calculated from the potential radius. All this was fully explained by tables and examples

Mathematical Society, February 10—Mr S. Roberts, F R S, president, in the chair—Mr. W. Woodruff Benson, University of Michigan, was elected a member, and Prof. Rowe and Mr J Parker Smith were admitted into the Society.—The following communications were made:—On some integrals expressible in terms of the first complete elliptic integral and of gamma functions, by Mr J. W L. Glaisher, F.R S—Some theorems of kinematics on a sphere, by Mr E. B Elliott, M A—Supplement on binomial biordinates, by Sir J Cockle, F.R.S. —An application of conjugate functions (to the case of membranes), by Mr E J Routh, F.R.S.—Note on Abel's theorem, by Mr. T. Craig.

Linnean Society, February 3—Robt. McLachlan, F.R S., in the chair—Lieut.-Col. A. A. Davidson was elected a Fellow —Examples of Prof C. Semper's method of preserving the soft tissues of animals as teaching specimens were exhibited on behalf of Herr L. Wurth of Wurzburg—Mr G. Murray exhibited and made remarks on a Japanese book containing wood sections —Mr. C. Craig-Christie exhibited, and a note was read on, the presence of what appeared to be deciduous stipules in *Ilex aquifolium*, thus contrary to the usually-accepted assertion that the order Ilicineæ is exstipulate—The following paper by Mr G Bentham was read "Notes on Cyperaceæ; with special reference to Lestiboudois' Essay on Beauvois' Genera' The essay in question was founded on Palisot and Beauvois' MS, which was originally intended to follow his "Agrostographia," and has been almost entirely lost sight of, and random guesses have been made at the species intended by the short characters given in Roemer and Schultze's "Systema"—Nees von Esenbeck, in the 7th, 8th, and 10th vols. of the "Linnæa," and Supplement 123, or Kunth in vol ii of his excellent "Enumeratio," appear to have correctly identified many of these Eighteen so-called genera are now referred to various established genera Steudel's Synopsis is marred by the author's hazy ideas of species Boekeler has a thorough knowledge of species, but his diagnoses are often excessively long. Mr. Bentham proposes few changes in the order of genera as set forth by Kunth, and he considers that Boekeler's primary division of the order as to whether the fertile flower is hermaphrodite or female only, bears the test of detailed examination.—Hermaphrodite flowers—(1) Scirpeæ, (2) Hypolyteæ, (3) Rhyncasporeæ Unisexual flowers—(1) Cryptangeæ, (2) Scheriæ, (3) Cariceæ—A paper was read by Mr. A D. Michael, observations on the life history of Gamasinæ. In this the author endeavours to decide some of the disputed and knotty points in reference to these humble parasites, M

Megnin of Versailles and Dr Kramer of Schleusingen, both good authorities on the subject, being at variance thereon. Mr. Michael, believing that detached observations on captured specimens may have produced unreliable results, has himself bred Gamasids, closely followed their changes and growth, and watched their manners, and thus has arrived at what he on good grounds assumes to be important results respecting their life-history. He states that the remarkable power of darting each mandible separately with speed and accuracy of aim far in advance of the body, the powerful retractile muscles attached to these mandibles, the organisation of the remainder of the mouth, the extreme swiftness of the creatures, the use of the front legs as tactile organs only, and not for the purpose of locomotion, and the ample supply of tactile hairs in front only, seem to fit the animals for a predatory life, and point to habits similar to those of *Cheyletus* and *Trombidium*, rather than to those of the true vegetable feeders, such as the Orbatidæ and Tetranachi. He further concludes (1) that Megnin is correct in saying *Gamasus coleoptratorum* and other allied creatures, with the conspicuously-divided dorsal plates, are not species at all, but are immature stages of other species; (2) that the division of the dorsal plate is, in most cases at all events, a question of degree, and does not form a sound basis for classification, as applied by Koch, Kramer, and others; (3) that the dorsal plates do not grow gradually, but alter in size, shape, or development at the ecdysis; (4) that Megnin is right in saying that the characteristic of the so called *G. marginatus* is simply a provision possessed by the females of a large number of species; (5) that the extent of the white margin depends upon the extent to which the abdomen is distended by eggs; (6) that Megnin is in error in saying that *Coleoptratorum* is the nymph of *Crassipes*. The nymph of *Crassipes* does not show any divided dorsal plates which can be seen on the living creature; (7) that in the species bred there has not been observed any inert stage before the transformations or ecdysis; (8) that in the same species copulation takes place with the adult female, and not with the immature one, as Megnin contends, and that it is by the vulva, not the anus.—Two papers were read on the coffee leaf disease (see Science Notes, p. 354).

Institution of Civil Engineers, February 8.—Mr. Abernethy, F.R.S.E., president, in the chair.—A paper on the temporary works and plant at the Portsmouth Dockyard Extension, by Mr. C. H. Meyer, Assoc. M. Inst. C.E., was read.

PARIS

Academy of Sciences, February 7.—M. Wurtz in the chair.—The following papers were read:—On photographs of nebulæ, by M. Janssen. It is comparatively easy to get a photographic image of the brightest parts of nebulæ, but very difficult to get complete images which may serve for future comparison. The optical and photographic conditions should be exactly defined. M. Janssen suggests taking for criteria images of stars, with plates a little out of focus, so as to give an opaque circle. Five or six of these stellar circles accompanying the photograph of a nebula would indicate what the conditions had been.—On the thermic formation of pyrogenic carburets, by M. Berthelot.—Some remarks on the characters of chloro organic gases and vapours, by M. Berthelot. The formation of a white precipitate in neutral or slightly acid nitrate of silver, traversed by a gaseous current, is not a sufficient character of chlorine or hydrochloric acid.—Examination of materials from some vitrified forts of France; conclusions, by M. Daubrée. The methods of producing these forts seem to have been various. To soften a rock like granite (sometimes used), to fuse its mica, and even, at times, its felspar, in thicknesses of several metres, implies large use of fuel and prolonged skilful effort. The fire was probably applied *within* the walls, and a current of forced air may have been used, besides draught. The makers unconsciously produced some minerals that have only of late been reproduced in the laboratory.—On the Great Canal de l'Est and the machines set up to ensure its alimentation, by M. Lalanne. This canal (made in consequence of the change of frontier in 1871) runs from near Givet, on the Meuse, by Mezières, Sedan, Commercy, Toul, &c., to Port-sur-Saône (it includes, in a total length of 468 km., 20 km. of the canal from the Marne to the Rhine). There are two large pumps in the Moselle valley, worked by the water of that river, also steam-pumps at Vacon. Two large reservoirs are projected, one near Paroy, the other at Aouze.—Study of actions of the sun and the moon in some terrestrial phenomena, by M. Bouquet de la Grye.—Observations of Perseids at Toulouse Observatory in 1880, by M. Baillaud. 1172 falling stars were counted on August 9, 10, and 11; the maximum was on the 10th, between 14h. and 15h. The trajectories were generally very short, and their extremities pretty far from the radiant point. The meteors were divisible into two groups.—On modes of transformation which preserve lines of curvature, by M. Darboux.—On simultaneous linear differential equations, with rational coefficients, whose solution depends on the quadrature of a given irrational algebraic product, by M. Dillner.—On a property of the product of k integrals of k linear differential equations, with rational coefficients, the solution of which depends on the quadrature, respectively, of k rational functions of the independent variable, and of a given algebraic irrationality, by the same.—The problem of remainders in two Chinese works, by M. Matthiessen.—On a peculiar phenomenon of resonance, by M. Gripon. A tuning-fork, giving a simple sound, will set in resonance masses of air which produce a sound comprised in the harmonic series of the fork's sound. The form of the mass of air is unimportant. One grave fork set in vibration forks which gave harmonic sounds, but not others, the two forks being connected by very fine copper wire (stretched).—On elliptic double refraction, and the three systems of fringes, by M. Croullebois.—On a new apparatus for showing the dissociation of ammoniacal salts, by M. Tommasi. In a glass tube is hung with platinum wire a strip of blue litmus paper that has imbibed a concentrated solution of chlorhydrate of ammonia. On putting this dissocioscope in boiling water, the sal-ammoniac is dissociated and the paper turns red; if then put in cold water the dissociated ammonia combines again with the acid, and the paper turns violet again.—On derivatives of acrolein, by MM. Grimaux and Adam.—Action of hydrochloric acid on aldehyde, by M. Hanriot.—Inoculation of the dog for glanders, by M. Galtier. The dog may contract the disease (through inoculation) and recover many times; but its receptivity (comparatively small at first) gradually diminishes, and, there is reason to believe, may be quite effaced. The power of the virus is attenuated by successive cultivations in the dog; this appears in an ass, *e.g.* inoculated with the later virus of a dog inoculated several times.—Physiology of dyspepsia, by M. Sée. In grave dyspepsia the stomach pump may advantageously be used to clear the stomach of liquids unfavourable to digestion.—On the histology of the pedicellaria and muscles of the sea urchin (*Echinus sphæra*, Forbes), by MM. Geddes and Beddard.—Researches on the development of sterile sporangia, in *Isoetes lacustris*, by M. Mer.

VIENNA

Imperial Academy of Sciences, February 10.—V. Burg in the chair.—C. Heller, on the distribution of the fauna of the high mountains of Tyrol.—R. Maly and F. Hinsteregger, studies on caffeine and theobromine (second paper).—V. Hochstetter, on the Kreutzberg Cave, near Laas, in Carniola, and *Ursus spelæus*.—R. Puluj (1) on radiant electrode matter; (2) remarks relating to the priority claimed by Dr. Eugen Goldstein.

CONTENTS

THURSDAY, FEBRUARY 24, 1881

PROFESSOR MAX MUELLER AT UNIVERSITY COLLEGE

UNIVERSITY COLLEGE, London, is to be congratulated on the fresh step which was celebrated on Wednesday last week. The new wing which was then formally opened, and which will be largely devoted to scientific teaching, and let us hope research as well, will give the College more elbow-room in its career. Of course the "toasting" and speechifying at the dinner were largely collegiate, the speakers generally expressing their approval of the principles upon which University College and similar institutions have been founded. We have repeatedly called attention not only to the admirable educational work which University College has done since its foundation, but to the influence it has had on the higher teaching all over the country. Not only has it been in a sense the parent of not a few similar institutions, the number of which is almost every year on the increase, but it has undoubtedly had much to do with rousing from the lethargy of generations the two oldest and wealthiest universities of the country. Much as has been done recently in the way of reforming these two great educational centres, the work has been little more than begun. The advocates of university reform may therefore congratulate themselves that Prof. Max Muller was called upon to reply to the toast of "British Universities." His reply was not likely to be, and certainly was not, compounded of the common-places usually uttered on such occasions. Prof. Max Muller has reason to be grateful to Oxford, and his gratitude he expressed in terms of genuine tenderness. "At the same time," he went on to say, "Oxford, or at all events my friends at Oxford, have no feelings but those of sincere rejoicing at the springing up, and growing, and spreading of what may be called the young universities, the universities of the future. We watch them rising in every part of England as we watch the rising of new planets. We greet them as on a stormy night we greet new lighthouses coming into sight and shooting their rays of electric light through the darkness—yes, the darkness of this so-called enlightened century, the darkness visible, and best visible to those who have spent their lives in the study of even the smallest subject, and know how every one of them still bristles with problems that cannot be solved without a large collection of new facts, and without bringing to bear on them more powerful batteries of thought than are yet at our command."

Prof. Muller was so far loyal to his *Alma Mater* as to admit that the Oxford of the past has done good work, but the Oxford of the present is doing better work, and we trust with him that the Oxford of the future will do infinitely better work still. How the desirable end is to be accomplished is a problem that all true friends of learning in the country are anxious to have solved, and to attempt to solve which the recent Universities Commissioners were appointed. We do not mean at present to criticise the work which these Commissioners have been attempting to do, how far short that work is of anything like a high standard of reform may best be seen by comparing what is known of their recommendations with the aspirations expressed in Prof. Max Muller's admirable speech.

"To compare the work that Oxford or Cambridge could do, and ought to do, with that of any other university, whether British or Continental, is simply absurd. Oxford, with its excellent material, the well-fed and well-bred youth of these islands; Oxford, with its many students who have not to work for their bread; Oxford, with its rich colleges and libraries and fellowships, can do for the advancement of learning fifty times over what Giessen or even Leipsic can do. Oxford and Cambridge could beggar the whole world and make the old universities the home of all English genius, all English learning, all English art, all English virtue."

Alas, how far are we from realising what Prof. Muller modestly called his "German dreams"! But that these "dreams" are perfectly realisable Prof. Muller went on to show by facts and figures based on the report of the Commissioners themselves. Why, in accordance with his suggestion, should a certain number of prize fellowships at Oxford not be thrown open to the whole of England? Prof. Muller's suggested scheme is as wide and liberal as the most advanced friends of education could wish, including the practical endowment of research in all departments of literature, science, and art.

"Prize Fellowships," he went on to say, "are in future to be tenable for five or seven years only. This is quite right. But if after five or seven years a young man has developed a taste for scientific work and wishes to continue it, then let him have a second Fellowship, again with duties attached to it, and let that man, with the proceeds of two Fellowships, do the work and fill the place which the Extraordinary Professors fill in Continental universities. Lastly, if after another five years the few who remain true to a scientific life can show that they have done good work and are able and willing to do still better work, let them have a third Fellowship and become permanent Professors in the University on an income of about 1000*l.* a year for life. I must not enter into fuller detail," Prof. Muller went on, "I only wanted to sketch out to you how the national funds of national universities could be made to subserve truly national interests; how Prize Fellowships could be made a blessing both to the giver and the receiver, and how England could stamp out of the ground an army of, call them soldiers, or missionaries, or colonists, or men—true men of science, such as the past has never dreamt of. All this could be done to-morrow, and no one would suffer from it. I know I shall be told—in fact I have been told—that such changes are far too great; that the fathers who send their boys to Oxford and Cambridge would not approve them, and this is always the last trump—that public opinion is against them. With regard to public opinion, if public opinion—if Parliament—is against us we must bow and wait. As to the fathers of boys—*ces pères de famille*—I am one of them myself, and I do not think we are always the most disinterested judges. As to changes, great or small, Nature teaches us that nothing can live which cannot grow and change, and history confirms her lesson that nothing is so fatal to institutions as a faith in their finality."

The scheme is one which, in its essential points,

has received the approval of the *Times* "In fact," that journal concludes, in a leading article on the speech, "if the objects proposed by Prof Muller for attainment are desirable in themselves, there ought to be no difficulty in obtaining funds for the purpose In view of what the Commissioners have sanctioned in principle for one College at least in Oxford, it can hardly be said that the objects aimed at are either very visionary or very far in advance of public opinion If Prize Fellowships may legitimately be used for the purpose of giving some men a start in ordinary life, it is difficult to see why they should not also be used, within reasonable limits, for giving others a modest provision for the pursuit of a learned career "

Why not? every one is likely to repeat except those who imagine they have a vested interest in being supported in idleness on what is really the property of the nation. By so doing, the university would once more make an approach to what it was intended to be, a really national institution The change would incommode none but idlers, and those who have at heart the real advancement of science and learning must be convinced that the present isolation of both universities can lead to nothing but stagnation. Oxford especially, with its silent and all but deserted laboratories, could only gain by an accession of activity from the outside Only thus indeed, only by having regular additions of fresh energy, can the place be kept sweet and wholesome, and if once this principle be accepted, as indeed it must be, and the sooner the better, there need be little difficulty in regulating its application. At present it would be difficult to calculate how much of the best intellectual energy of the country is wasted or misapplied, simply because there is no channel open by which it may be guided into the course in which it could do the best work.

There were several other subjects touched upon by the speakers at the University College dinner, to which we have not space to refer Prof Morley's tribute to the memory and the work of Mr. Carlyle was well-timed and appropriate, coming as it did just when the country was awed by its recent loss. Mr Carlyle often said hard things of science, as he did of everything else under the sun. All the same, his methods and his philosophy were as scientific as they could well be, being simply his peculiar applications of the doctrine of the reign of inevitable law everywhere Apart from this, and while we might disagree with everything he said and positively taught, it must be admitted that the inspiration of his teaching gave fresh energy and earnestness to scientific research, as it did to every other sphere of intellectual activity.

ATLAS OF HISTOLOGY

Atlas of Histology By E Klein, M D, F R S, and E Noble Smith, L R C P, M R C S. (London Smith, Elder, and Co, 1880.)

MODERN histology is not yet fifty years old, but fifty years old in the nineteenth century means a great deal, and it is rather a matter of surprise that no English work entirely devoted to histology should have yet appeared than that we should be welcoming the largest and in some respects the most important illustrated work on that subject in this or any language.[1]

That modern histology is most faithfully represented in the book before us becomes abundantly evident on looking at the figures and their description. We find the tissues and organs of the body delineated under every aspect and after every possible method of treatment, hardened with chromic acid, osmic acid, picric acid, stained with hæmatoxylin, carmine, aniline blue, submitted to the action of gold and silver salts and otherwise prepared *lege artis*. Of the value of these in elucidating structure there can be no question whatever, but at the same time we think it would have been well in a comprehensive work of this description had more space been given to the representation of the tissues in their living condition and unaltered by the action of reagents · the almost complete absence of allusion to and representation of the fresh tissues being a defect in the book

Dr Klein, in selecting the subjects for illustration, and Mr Noble Smith in executing them, alike deserve high praise. Many of the figures are evidently as near an approach to facsimile of the preparations as can well be attained, and it need hardly be said that the preparations themselves, made as they are by so skilful a histologist, are as good in all probability of their kind as it is possible to make them.

In looking through the plates one is especially struck with the excellent manner in which the minute anatomy of the various organs is detailed, indeed the part of the work which relates to the structure of the viscera is in all respects better than that in which the simple tissues are dealt with. The illustrations of the latter are comparatively meagre, and in many cases too small, considering the size and aim of the work This is very marked in the figures of the blood and in those of cartilage and osseous tissue, as well as in the illustrations of the structure of voluntary muscle On the other hand, the development of bone is well and carefully represented, especially so far as the more intimate processes are concerned, but we miss the general features of bone-formation, such as the first calcification of the primitive cartilage bone, the periosteal irruption, and so on. The nervous tissue is also abundantly and beautifully illustrated, and here we are glad to observe that Dr Klein has availed himself of the magnificent representations given by Key and Retzius in their monograph on the nervous system, representations that could scarcely have been improved upon, and to compete with which would have involved needless labour.

That the lymphatic system should occupy an important part of the work was to be expected from the fact that we already owe to Dr Klein two monographs wholly devoted to that system, and from them, as well as from the plates in the "Handbook for the Physiological Laboratory," some delineations are here republished. With the exception of these and one or two other less important instances the figures throughout the book are new, and will no doubt for many years furnish a stock to which both teachers and authors may come for diagrams and illustrations.

As before remarked, the representations of the minute structure of the viscera are particularly good, and will prove useful in replacing many of the coarse and semi-diagrammatic figures which at present occupy a prominent place in the text-books of histology and physiology. We

may signalise those of the stomach and those of the kidney—the structure of the last-named organ being illustrated with particular minuteness One is glad to think that one's examinations are over on finding that there are now no less than sixteen several named parts to be remembered in describing the course of a uriniferous tubule!

We have hitherto been writing as if the book before us were an Atlas of Plates and their description, and nothing more This is emphatically not the case however, for the plates are accompanied by a text written by Dr Klein, which forms a complete and independent compendium of the present state of histology, giving in plain terms and as briefly as is consistent with clearness, an account of the minute structure of each tissue and organ In this account credit is given wherever possible to those to whom the discovery of new facts is due, but it is, we think, to be regretted that the references to the works in which the facts were published has not been added, such a notice of the literature of each subject would have been of much value.

At the end of the book a description of the appearances which are presented by nuclei in process of division will be found, embodying the results of the recent researches of Strasburger, Flemming, Mayzel, Klein, and others, results which have not unnaturally created a feeling of wonderment that in objects which have long engaged the special attention of histologists, changes of so marked a character should occur, and until now have wholly escaped observation.

We see that endothelium is still described as a tissue distinct from and indeed in contradistinction to epithelium, but it seems to be upon its last legs, for it now has to depend for existence upon a negative definition, and no longer presumes to base its claims to the place upon its developmental history

There is a general tendency throughout the text to teach the subject somewhat dogmatically, and this, with the absence of detailed reference to literature, detracts from its value as a work of reference, while perhaps increasing its value as a text-book for students. Taking the work however as a whole it is not too much to say that it is in every way worthy of the high reputation of its principal author, and that its appearance, supplying as it does a want that has been long felt, will be welcomed by histologists both at home and abroad.

OUR BOOK SHELF

Urania an International Journal of Astronomy. Edited by Ralph Copeland, Ph.D, and J. L E. Dreyer, M A.

THE first number of what is intended to be a high class astronomical periodical, with the above title, has just appeared, and forms twenty-four pages demy quarto. It is proposed to issue it in numbers of from sixteen to twenty-four pages, whenever sufficient material offers, with shorter numbers when subjects of immediate interest require it Papers will be accepted and printed in French, German, and Italian. This first number is well supported It contains an article on the solution of Lambert's equation by Prof. Klinkerfues, and auxiliary tables for the calculation of occultations of stars by the moon, by Dr. C. Borgen. The Earl of Crawford and Balcarres contributes observations of comets 1880 *b*, *c*, and *d* made at Dunecht; the Earl of Rosse has a paper on determinations of lunar radiant heat during an eclipse; and Dr R S Ball communicates an investigation of the parallax of the star Groombridge 1618, which is No. 89 in Argelander's list of stars with large proper motions, the observations having been made at Dunsink in 1878-79 a parallax to the amount of a third of a second is indicated by the measures both of distance and position, so that, as Dr Ball remarks, there is reason to consider Groombridge 1618 entitled to a place amongst the sun's nearest neighbours Dr Copeland has a note upon a nebula detected at Dunecht on the method of sweeping suggested by Prof Pickering of Harvard College, U S, which is termed "a new planetary nebula." The nebula however is not new; it was discovered several years since by Mr S C Burnham with a refractor of 6-inches aperture, and was notified at the end of his third catalogue of new double-stars. it is referred to also in the notes to his observations of double-stars in 1877-78, in the *Memoirs* of the Royal Astronomical Society, vol xliv he found it to be double, the distance between the centres of the two parts and a star of 9m (which appears to be *Durch* + 47°, No 3289), being 27″ 3 at the epoch 1878·47 The double nucleus has also been remarked at Dunecht, and the measures of position and distance made there have a particular interest when compared with Mr Burnham's in 1878, thus we have—

Burnham, 1878 476	Position, 88°5	Distance, 2″57
Dunecht, 1880 913	,, 71 9	,, 8·00

Such differences surely indicate rapid motion Dr Copeland does not allude to the star of about ninth magnitude distant less than half a minute of arc in 1878 This journal may be obtained by applying to Mr J L E. Dreyer, Observatory, Dunsink, Co Dublin.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications*

The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts]

Infusible Ice

PROF. CARNELLEY'S directions in NATURE, vol xxiii p. 341, just received, for producing the hitherto fabulous commodity, "hot ice," have succeeded so much beyond our expectations for a first experiment in our College laboratory to-day, that the ease and simple means with which the experiment was performed, and the unaccountable and unaccustomed appearances which it presented, recommend it very strongly, as Prof Carnelley remarks in his paper, and as I hope that the following description may also serve to prove, to other observers' trials and repetitions.

A 30 oz flask of stout glass (made nearly as strong as the Carré decanters, for vacuum experiments) was tightly fitted, by forcing a two inch plug of large solid india-rubber tube placed round a tube into its mouth and firmly fixing it there with wire, with a delivery-tube of three eighths of an inch large glass barometer-tube about two feet long. This tube was bent into an S-shape, and at the extreme end of the small U-part, which turned up, it was drawn out to a nearly capillary neck and bent over to communicate by india-rubber tubing through another similar flask surrounded by cold water to act as a condenser, with a Swan's aspirator giving a vacuum of twenty-eight inches by the action of the town water supply About 15 oz. of distilled water previously introduced was now boiled in the flask *in vacuo*, and distilled over, at a very gentle heat, into the second flask After two or three hours' boiling the quantity of water in the flask was reduced to about 3 oz., and the capillary end of the tube was then sealed with a blowpipe. The flask thus exhausted makes an excellent water hammer and cryophorus, ringing with sharp raps when the water is shaken to and fro in it or in its tube. The least warmth of the flask, or cold applied to the U-part of the tube, suffices to collect there, by distillation, a quantity of beautifully clear water completely freed from air.

To obtain the rapid evaporation and superheated state of ice, the U part of the tube was placed in a freezing-mixture of ice and salt till the condensed water coated the tube internally with a hollow sleeve of ice extending in the long and short parts of the U to a total length of about eight inches, and the flask itself was thereupon placed in a sawdust-bedded tin pail containing a large freezing-mixture of 5 lbs of salt and 10 lbs of pounded ice. Hydrochloric acid was at the same time added to the frigorific mixture round the U-tube, lowering the temperature of that part of the cryophorus to -29° C (-20° F), which had the effect of cracking the ice sleeve (apparently by contraction) in all directions, giving rise at first, from its appearance, to the apprehension that the glass tube was completely splintered! Now came the critical operation. Would the hard frozen ice-coat bear the application of the heat ordeal without melting?

The freezing mixture round the U-tube was replaced by cold water in a water-bath, which was heated rapidly with a Bunsen-flame. About two inches of the ice-sleeve in the long part of the tube stood above the surface of the water, the rest soon melted, while the temperature of the water in the bath rose to 70° C., and a thick rime of white frost from the condensed vapours of this water formed round the tube containing the projecting part of the ice-tongue, which must have been intensely cold, since the rime almost touched the surface of the warm water. Below the surface of the water the tube appeared always to contain some snowy-looking solid, along with what resembled water proceeding from its liquefaction. When the temperature of the bath reached 70° C. the projecting ice tongue was still unmelted, it had replenished itself by condensing and freezing the vapours rising up to it from below, and formed a snowy plug in the tube an inch or more long.

The water-bath was then removed in order to heat this snow-plug with a Bunsen flame, and to our extreme surprise a similar snow-lining was found still to remain coating, quite dry, the whole long part and much of the short part of the U-bend. The flame was applied, and the whole tube was heated violently without for some time appearing to have the least effect upon the white crust within, notwithstanding the tube was too hot to be touched! A small flake weighing at most a few tenths of a grain, at the bottom of the U, withstood the strongest heat there for several minutes, wasting insensibly away, and unchanged in shape, until it vanished with perhaps a moment's collection to a drop as it disappeared. As it slowly grew thinner the white coating in the tube seemed in general to be no more affected by the heat than white feathers would have been, but in particular parts there often occurred partial liquefaction or pasty fusion allowing pieces of the film to turn over by their weight and roll or slip down the glass while still adhering to it, quite in the manner of drops. That the liquid itself, completely freed from air, refuses to boil, and may be described in that respect as practically *oily*, was evident enough in the preparation of the flask, when except by sudden bumps the distillation of vapour, however much it was urged by heat, and seen to be passing copiously through the bent worm-tube, proceeded almost entirely from the surface of the water in the flask.

In these drops at least, adhering to the heated glass, it seems difficult to believe that the solid ice which makes them angular, jagged in form, and pasty, can be anything but superheated, and it seems also scarcely credible that the latent heat of sublimation of the insignificant weight of a few grains of ice-crust in the tube resisting its strong heat for many minutes can reach the large amount of its gain of heat in that time by conduction and radiation from the surrounding tube, if the ice-film is at no higher temperature than its natural melting-point. These are questions however which the calorimetric methods devised and pursued by Prof. Carnelley are best designed to answer, and to which replies without such positive determinations can only be urged at present as probable conjectures, or as clear preceptions and presentiment, on the other hand, of the action and operation of some hitherto undiscovered thermal laws.

Whether by direct sublimation, or by evaporation accompanied by liquefaction, the slender snowdrift with its enlargement at the top was gradually reduced in thickness, and subdivided into remaining parts along its length, which all adhered to the tube until they wasted away, and the largest top piece never fell by withdrawal of support below, but, like the rest, it clung like a thin scale to the last to its original place on one side of the tube. This power of adhesion of hermetically volatilised ice to hot bodies with which it is in contact forms, as Prof. Carnelley observes, one of its most marked, although not at all one of its most prognosticable, properties, and it certainly prompts, if it does not unequivocally substantiate, the supposition that the ice in such close contact with extremely hot bodies must be superheated, or at a temperature sensibly higher than its natural melting point.

The perfect success of the experiment and the beautiful appearance of the ineffaceable white snow-lining of the tube afforded us unqualified pleasure and surprise, and the simple preparation and preservation of the cryophoric apparatus needed for its exhibition will, I have no doubt, cause the experiment to be often reproduced and shown wherever freezing-mixtures and the cryophorus, and Boutigny's and Leidenfrost's phenomena, and Prof. Carnelley's theory and researches, are subjects of lecture-demonstrations. A. S. HERSCHEL

College of Physical Science, Newcastle-on-Tyne, February 15

Dust, Fogs, and Clouds

I NEED not say that the information contained in M. H. J. H. Groneman's letter in NATURE, vol. xxiii. p. 337, was a most unexpected surprise. Nothing whatever seems to have been known in England about the results obtained by Messrs. Coulier and Mascart, and my astonishment was not diminished when I considered that their important investigation had borne no fruit, never having been practically applied by meteorologists or others.

I have just seen the article by M. Coulier in the *Journal de Pharmacie et de Chimie*, and will (with your permission) make a few remarks on his paper and on my own. M. Coulier was led to the discovery of the important part played by dust in the condensation of vapour, by making experiments on the well-known cloudy condensation produced by expanding saturated air. Instead of the ordinary air-pump arrangement M. Coulier's apparatus consisted of a glass flask, in which was placed some water. This flask was connected by a tube to a hollow india rubber ball. He first compressed the india-rubber ball, thus compressing the air in the flask. The pressure was then removed from the ball, when the air in the flask expanded, and the condensation became visible.

In making repeated experiments with this apparatus M. Coulier noticed that the action of the air was capricious. After the air had remained in the flask some days he found it quite inactive. He also found it inactive after shaking it up with the water in the flask, and that on expelling some of the inactive air and replacing it with the air of the room the cloudiness again appeared. He then found that if he filtered the air before admitting it to the flask it did not give any cloudiness when expanded, and he explains with perfect clearness that the dust in the air formed the nuclei on which the vapour condensed.

Having explained the manner in which M. Coulier approached the subject I shall now give the history of the corresponding part in my work and show the direction from which I approached it. I had been studying the action of "free surfaces" in water and other forms of matter, when changing from one state to another. I knew that water could be cooled below the freezing-point; I was almost certain ice could be heated above the melting-point, and I had shown that water could be heated far above the boiling point, that the material of which the vessel holding the water was composed had no influence on the result—and all that was necessary to prevent the change of state taking place, at the freezing and boiling points, was an absence of "free surfaces" at which the change could begin. Arrived at this point, the presumption was very strong that vapour could be cooled below the "condensing point" without changing to water, if no "free surfaces" were present. I first intended to experiment with steam at the pressure of the atmosphere, but found difficulties in operating at so high a temperature. I then made arrangements to conduct the experiments at a lower temperature, and for convenience experimented on steam mixed with air. I then saw that dust in the air would form "free surfaces" on which the vapour would condense. I therefore attached a cotton-wool filter to the apparatus, and filtered the air before it entered the receiver. When this was done I found that the steam on entering the receiver was perfectly invisible, and gave rise to no cloudy condensation, the air remaining supersaturated. The experiment was immediately afterwards repeated somewhat in the same way as was done by M. Coulier, the air being supersaturated by expanding it by means of an air-pump.

Though the two investigations approached the subject from very different points, they seem afterwards to have flowed in almost parallel directions. Starting from his first experiments,

M. Coulier made experiments with the products of combustion from flames in which the combustion was as perfect as possible He found these gases much more active than the air of the room This he attributed to particles of unconsumed carbon He also found the air after rain and storms to be less active, and the air in summer less active than in winter. After extending the experiments to alcohol and benzine, the paper concludes with some remarks on the peculiar action of ozone

Up to this point the two investigations run perfectly parallel, and the strange likeness between the two sets of experiments is not the least interesting point connected with them After going over this first paper by M Coulier, I found he had communicated a second paper, which will also be found in the same volume of the *Journal de Pharmacie et de Chimie*, at page 254 This second paper is almost entirely occupied with a description of some experiments in which inactive air was heated and rendered active

In the first experiment described in M Coulier's second paper a platinum wire was heated in the purified air of the flask, after which the air was active In the second experiment pure air in which hydrogen was burned became active In the third experiment pure air which was passed through a glass tube surrounded with tinsel ("clinquant"), and moderately heated, was made active Fourth experiment, oxygen, nitrogen, and hydrogen became active after they had been heated in a tube After describing some effects in ventilation when *highly* heated air is used, he says, "In the preceding note (the first paper) I believed I could attribute the activity of the air to the presence of solid bodies, and it seemed to me that the only solid body that could escape from a carbon flame could be nothing but carbon itself It was the remarkable experiment, so easily made, of filtering air through cotton wool, that led me to form this hypothesis, which the experiments above related invalidate (à faire cette hypothèse, que les expériences relatées plus haut infirment)" He concludes by saying, "The explanation of these phenomena remains still to be found"

Experiments exactly corresponding to some of those described in M Coulier's second paper will be found in mine Wishing to test the effect of combustion on air, I first made experiments to test the effect of heat on the apparatus to be used in collecting the hot gases. For this purpose I passed filtered air through a heated glass tube, after which I found it was remarkably active. It was found however that this activity is not due, as M. Coulier seemed to suppose, to the heating of the air, but to impurities driven off the surface of the tube by the heat This was proved by showing that the air remained inactive when the hot tube through which it was passed was thoroughly cleansed

In making experiments on the effect of burning gas I arranged a platinum wire, connected with a battery, to enable me to light the gas in the pure air of the receiver On testing the action of the heated wire alone, it was found that simply heating the wire gave rise to cloudiness. It was however found that by highly heating the wire its activity was destroyed, all impurities being driven off

These experiments explain M Coulier's first and third experiments The fourth experiment is also to be explained by the nuclei driven off the tube by the heat These nuclei may be driven off in the solid state, or as gases which condense without nuclei when *highly* supersaturated on being cooled to the temperature of the flask The nuclei are in some cases formed by chemical union of the gases driven off by the heat, and in other ways unnecessary to enter upon here As to the second experiment, more information is required as to arrangement of apparatus, &c, before any opinion can be formed as to the origin of the nuclei

It now appears to me that this second paper explains why the first results of M. Coulier, though repeated and confirmed by M Mascart, have not received that general acceptance we should have expected. In his second paper he describes a number of results which he did not succeed in fitting into his hypothesis They even seemed to him to shake his first conclusions, and the uncertain sound given by his second paper seems to have blighted any fruit his first paper was likely to have produced. There can however be no doubt that M. Coulier was the first to show the important part played by dust in the cloudy condensation of the vapour in air, and his first paper clearly explains its action. It seems highly probable that if it had not been followed by his second paper, or if he had succeeded in getting the key to the explanation of his experiments, and his conclusions had confirmed instead of weakening the teaching of his first paper, his result would long ere now have been applied to explain the different causes and the different forms of cloudy condensation in our atmosphere, as well as other physical phenomena

Darroch, Falkirk, February 15 JOHN AITKEN

Geological Climates

I DESIRE to express my thanks to Dr John Rae for the valuable contribution of "facts" which he has added to this interesting question, of which I hope to make use in due time

I wish also to answer the question asked by Prof Woeikoff in his letter of February 17 My authority for January, July, and mean temperatures in the northern hemisphere and in the southern is the most recent and accurate available, viz, United States Coast Survey, "Meteorological Researches for the use of the Coast Pilot," Part 1, by William Ferrel (Washington, 1877). Mr Ferrel gives the January and July temperatures for every ten degrees of longitude and latitude, up to 80° N and 60° S. as follows, so far as regards the annual means —

Lat N	Annual	Lat S	Annual
0°	80°·1 F.	0°	80°·1 F
10	81·0 ,,	10	78·7 ,,
20	77·6 ,,	20	74·7 ,,
30	67·6 ,,	30	66·7 ,,
40	56·5 ,,	40	57·9 ,,
50	43·4 ,,	50	47·8 ,,
60	29·3 ,,	60	35·3 ,,
70	14·4 ,,	70	—
80	4·5 ,,	80	—

This table fully justifies what I said of the southern hemisphere as compared with the northern, and is, of course, explained by the existence of three great gulf streams in the south, which raise the mean temperature, producing insular climates with a small range from July to January

Mr Ferrel adds, at the close of his discussion (p 22) —

"From Dove's Charts of Isothermal Lines, which do not extend beyond the middle latitudes in the southern hemisphere, it has been inferred that the southern hemisphere is colder than the northern, and this has been the accepted view ever since his charts were first published, in the year 1852; but from the results obtained above it is seen that the mean temperature of the southern hemisphere is the greater of the two"

I was well aware that the east coast of Asia is colder, latitude for latitude, than the east coast of North America, but this has nothing to do with reducing the temperatures of the east coast of America, by means of alterations in the ocean currents of the North Atlantic, which I deny to be possible

SAMUEL HAUGHTON

Trinity College, Dublin, February 19

Climate of Vancouver Island

As questions connected with the climate of Vancouver Island and the influence on it of ocean currents have lately been the subject of several communications in the pages of NATURE, it may be worth while to draw attention to the fact that Esquimalt, at the southern extremity of the island, together with several places on the mainland of British Columbia, have now been for a number of years occupied as regular stations of the Canadian Meteorological Service, and that trustworthy meteorological results are to be found in the annual reports to Government.

When writing a report on British Columbia for the Canadian Pacific Railway Survey in 1877, I applied to Prof Kingston, then in charge of the Meteorological Department, for some information on climate, and received from him an abstract, which was published at the time ("Can Pacific Ry. Report, 1877," p 246), by which it appears that the mean summer temperature of Esquimalt is 57° 82 F., mean winter temperature 34° 45, mean annual temperature 47°·97. This does not include however the additional results of the last few years

Much information on the climate of the northern part of the north-west coast may also be found in the *Alaska Coast Pilot*, 1869, and the *U.S. Pacific Coast Pilot*, Appendix 1, 1879. In the latter, series of monthly and mean annual isothermal lines are given for the air and sea surface, which—though the observations at command are by no means complete—are doubtless nearly correct. A partial abstract of these, with some discussion

of the climatic features of British Columbia, may be found in an appendix written by me for the Canadian Pacific Railway Report of 1880, p. 107.

The mean temperature of Tongass at the southern extremity of Alaska, from two years' observations, is stated as 46° 5

Observations have been maintained at Sitka with little interruption for a period of forty-five years The latitude of this place is 57° 3', or about one degree north of Glasgow. The mean temperatures are as follows.—spring 41°·2, summer 54° 6, autumn 44° 9, winter 32° 5, and for the year 43°·3

According to the *Pacific Pilot* above quoted, that portion of the Kuro-siwo, having a temperature of 55° F or more, approaches the coast in the vicinity of Vancouver Island. Temperatures not much lower than this however prevail much further north The average temperature of the surface of the sea during the summer months in the vicinity of the Queen Charlotte Islands as determined by me in 1878 ("Report of Progress, Geological Survey of Canada, 1878 79") is 53°·8 Observations by the U S Coast Survey in 1867, in the latter part of July and early in August between Victoria and Sitka, gave a mean surface-temperature of 52° 1.

GEORGE M DAWSON

Geological Survey of Canada, February 1

"The New Cure for Smoke"

IT was not my intention to trouble you further on this subject at present, but as Dr Siemens has been good enough to notice the result of my trials with the coke-gas grate, and has asked a question with reference to the grate used by me, it is due to that gentleman that I should at once explain that the grate in which the trials were made is of modern construction and permanently fitted with side-cheeks and back of fire-clay lumps, and that when in use with the coke and gas the back was fitted with a copper plate, and in all other respects the grate was arranged in the manner described and illustrated in NATURE, vol xxiii p. 26

J A. C. HAY

On the Space Protected by Lightning-Conductors

THE very interesting article by Mr. W H Preece on the "Space Protected by a Lightning-Conductor" (*Phil Mag* 5th series, vol. x p 427 *et seq*, December, 1880) revives this important practical question. The old rule, first enunciated by M Charles, which makes the radius of the protected circular area around the base of the rod equal to twice its vertical height, has never been satisfactorily verified either on theoretical or experimental grounds This rule was adopted in the Report of the Commission of the French Academy of Sciences drawn up by M. Gay-Lussac in 1823 (*Ann de Chim et de Phys* 2nd series, t 26, p. 258), and also in two other reports drawn up by M. Pouillet, one in 1854 (*Comptes rendus*, t. 39, p 1142), and the other in 1867 (*Comptes rendus*, t 64, p 102) But still more recently the Committee appointed by the Préfet de la Seine to superintend the construction of lightning conductors in the City of Paris, in their Report in February, 1876, *reduced* the radius of the protected area to 1 45 times the height of the rod I am ignorant on what grounds the Commission adopted this precise number

In this state of the problem Mr Preece's paper was both apposite and welcome. The rule which he deduces certainly has the merit of *definiteness*, but it seems to me that it fails to be *practically satisfactory* For it is very evident that his investigation is exclusively applicable to "*Blunt-Conductors*," since the "*Power of Points*" is entirely left out of consideration. His deductions might apply to the *blunt* conductors which crowned the Royal Palace of George III, but are scarcely applicable to the *pointed* rods now employed! His investigation assumes that the *distance* of the earth-connected objects from the electrified cloud is the *only element* which determines the *direction* of the discharge It seems to me that the well established "power of points" to discharge, or rather to *neutralise* the electricity of charged conductors, is an essential element in the problem of the protected space.

It is a well-known fact that when an electrified cloud approaches a *pointed* lightning-conductor which is in good conducting connection with the earth, the sharp point becomes charged by induction with opposite electricity of *high tension* long before the distance between them approximates that required for a *disruptive* discharge, so that electricity of the opposite kind from that of the cloud *escapes* from the point in the form of a *connective discharge* or electrical *glow*, and *neutralises* that of the cloud, and thus silently *disarming* it, *averts* the disruptive stroke of lightning This *neutralisation*, due to the power of points, constituting the *preventive action* of lightning-conductors, is justly regarded as the *most important* function of such rods, although, under certain extraordinary circumstances, they may be forced to carry disruptive discharges. Under any circumstances, however, it is obvious that *pointed* conductors must *enlarge* the protected area as compared with *blunt* conductors

It is very difficult, if not impossible, to estimate in a precise manner how this *power of points* would *modify* and *distort* the *equipotential surfaces* in the intervening electric field The problem is evidently one of great complexity The following circumstances must obviously influence, to a greater or less extent, the *magnitude* and *direction* of the resultant electromotive force, which determines the path of discharge, *convective* or *disruptive*, viz (1) *Distance* of thunder-cloud from the point of the conductor, (2) variable *dielectric properties* of the intervening air, (3) *size* of the cloud, (4) the variable *tension* of its electric charge, especially under the neutralising action of the pointed rod, and (5) the *velocity* with which the thunder-cloud approaches the point of the conductor. The *last* consideration is very important, and at the same time most difficult to formulate; for the *convective neutralisation* is a *gradual* process requiring *time*. It is evident that a heavily-charged thunder-cloud *rapidly* driven towards the point of the conductor might give rise to a *disruptive* spark, while, if *slowly* approaching the same, it would have been *silently neutralised*, and the stroke averted. In fact the strength and direction of the resultant force is influenced by so many variable conditions that it would tax the resources of a powerful calculus to indicate a formula which would satisfy, even approximately, the demands of practice in the construction of lightning-conductors

Nevertheless, it is quite certain that Mr Preece's rule, which makes the radius of the protected circular area equal to the *height* of the rod for *blunt* conductors, is perfectly *safe* for *pointed* rods, for there can be no question as to the fact that the "power of points" *enlarges* the protected area.

The late Prof Henry frequently witnessed the efficacy of convective discharges from the point of the lightning conductor attached to the high tower of the Smithsonian Institution. During violent thunder storms at night, at every flash of lightning he observed that "a jet of light, at least five or six feet in length, issued from the point of the rod with a hissing noise."

It is proper to add that while the circumstances influencing *disruptive* discharges of electricity have been experimentally investigated by a number of physicists, the laws of *convective* discharges from points do not seem to have received attention from any experimenter Thus I have not been able to find a satisfactory answer to the following elementary inquiry, viz — Under given conditions, at what *distance* will a pointed conductor connected with the earth *begin* to neutralise the electricity of an insulated conductor by the convective discharge of the opposite kind of electricity from the point?

In short, the whole subject of the "power of points," although one of the best-established and most conspicuous phenomena in electricity, is sadly in need of experimental investigation. This class of electrical phenomena is pretty much in the same condition in which Franklin left it more than a century ago.

Berkeley, California, January 1 JOHN LE CONTE

[Mr Preece has shown by considering the area between the conductor and the charged cloud as an electric field mapped out in equipotential surfaces and lines of force, that "a lightning-rod protects a conic space whose height is the length of the rod, whose base is a circle having its radius equal to the height of the rod, and whose side is the quadrant of a circle whose radius is equal to the height of the rod"—*Phil Mag*, December, 1880 — ED.]

Localisation of Sound

MY friend the Rev H J. Marston, Second Master of the School for Blind Sons of Gentlemen at Worcester, has communicated to me some very singular instances of the power of localising sound possessed by blind boys.

One of the games in which his pupils most delight is that of *bowls*. A bell is rung over the nine-pins just as the player is ready to throw the bowl, when, totally blind as he is, he delivers it with considerable accuracy of aim. Mr Marston vouches for the fact that it is no uncommon feat for a boy to strike down a single pin at a distance of forty feet three times in succession.

It is significant that this game cannot be played by the blind boys in windy weather. And yet the allowance for windage on a heavy bowl can be no very large quantity

The boys also play football with great zeal and considerable skill. Bells are rung at the goals throughout the game, and the ball contains two little bells. With these guides the boys manage both to follow the ball and to direct it to the goals.

Clifton College, February 15 H. B JUPP

Migration of the Wagtail

THE inclosed extract from the New York *Evening Post*, a newspaper of high standing for accuracy and intelligence, contains statements which are not, I think, generally known in regard to the migration of the water-wagtail, and your insertion of the same may be the means of drawing from other correspondents some evidence in confirmation or disproof Though riding is not quite unknown among animals other than men, yet such purposeful riding as is here described is, to say the least, very extraordinary E. W. CLAYPOLE

Antioch College, Yellow Springs, Ohio, Dec 12, 1880

The Singular Methods of Travel the Wagtail adopts to Cross the Mediterranean Sea —In the autumn of 1878 I spent several weeks on the Island of Crete On several occasions the papas—village priest—a friendly Greek with whom I spent the greater part of my time—frequently directed my attention to the twittering and singing of small birds which he distinctly heard when a flock of sand-cranes passed by on their southward journey. I told my friend that I could not see any small birds, and suggested that the noise came from the wings of the large ones. This he denied, saying, "No, no! I know it is the chirping of small birds. They are on the backs of the cranes I have seen them frequently fly up and alight again, and are always with them when they stop to rest and feed" I was still sceptical, for with the aid of a field-glass I failed to discover the "small birds" spoken of. I inquired of several others, and found the existence of these little feathered companions to be a matter of general belief among both old and young. I suggested that possibly the small birds might go out from the shore a short distance and come in with the cranes. "No, no," was the general answer, "they come over from Europe with them." I certainly heard the chirping and twittering of birds upon several different occasions, both inland and out upon the sea. But in spite of the positive statements of the natives I could not believe their theory until convinced one day while fishing about fifteen miles from the shore, when a flock of cranes passed quite near the yacht The fishermen, hearing the "small birds," drew my attention to their chirping Presently one cried out "There's one," but I failed to catch sight of it Whereupon one of them discharged his flintlock Three small birds rose up from the flock and soon disappeared among the cranes

I subsequently inquired of several scientific men, among whom were two ornithologists, as to the probability of such a state of affairs They all agreed that it could not be, and I, too, was forced to cling to my original judgment, and let the matter go Recently however while reading the *Gartenlaube* my attention was attracted to an article bearing directly upon the subject The writer, Adolf Ebeling, tells the same story, and adds the statements of some ornithologists of distinction, which makes the whole matter so striking and interesting that I quote the paragraph from his book —

"Shortly after my arrival in Cairo I greeted various old German friends among the birds that I observed in the palm-garden of our hotel. First, naturally, was the sparrow, the impudent proletariat—I had almost said social democrat, because the whole world to-day has that bad word in the mouth. He appeared to me to be more shameless than ever in the land of the Pharaohs, for he flew without embarrassment on the breakfast table, and picked off the crumbs and bits from every unwatched place. But the mark of honour we paid to the wagtails, and in truth chiefly because we did not then know that the wagtails were birds of passage. We had thought that they passed the winter in Southern Europe, or at farthest as many of them do, in Sicily and the Grecian Islands. That they came to Africa, and especially to Nubia and Abyssinia, was then unknown to us. This appeared to us singularly strange, nay, almost incredible, particularly on account of the peculiar flight of the wagtail, which it is well known always darts intermittingly through the air in longer or shorter curves, and apparently, every few moments, interrupts its flight to sit again and 'wag its tail' But there was the fact, and could not be denied Everywhere in the gardens of Cairo you could see them under the palms that border the banks of the Nile; on the great avenues that lead to the pyramids, nay, even on the pyramids themselves in the middle of the desert. And there it was that I first heard of this singular phenomenon.

"One evening we were sitting at the foot of the pyramid of Cheops, sipping our cup of fragrant Mocha and in jolly conversation, rolling up clouds of blue smoke from our Korani cigarettes. We were waiting for the sinking of the sun to make our return to Cairo The deep silence of the surrounding desert possessed something uncommonly solemn, only now and then disturbed by the cry of the hoarse fishhawks far above us Still higher the pelicans were grandly circling Their flight, though heavy when seen from anear, possesses a majesty in the distance attained by no other bird. Right before us several wagtails were hopping around and 'tilting.' They were quite tame, and flew restlessly hither and thither On this occasion I remarked, 'I could not quite understand how these birds could make the long passage of the Mediterranean' Sheik Ibrahim heard this from our interpreter The old Bedouin turned to me with a mixture of French and Arabic as follows, which the interpreter aided us to fully comprehend —

"'Do you not know, Hadretch (noble sir), that these small birds are borne over the sea by the larger ones?'

"I laughed, as did our friends, for at first we thought we had misunderstood him, but no, the old man continued quite naturally —

"'Every child among us knows that These little birds are much too weak to make the long sea journey with their own strength This they know very well, and therefore wait for the storks and cranes and other large birds, and settle themselves upon their backs. In this way they allow themselves to be borne over the sea The large birds submit to it willingly, for they like their little guests, who by their merry twitterings help to kill the time on the long voyage'

"It appeared incredible to us. We called to a pair of brown Bedouin boys, pointed out the wagtails to them, and inquired —

"'Do you know whence come these small birds?'

"'Certainly,' they answered. 'The Abu Saad (the stork) carried them over the sea'

"At supper, in the Hôtel du Nil, I related the curious story to all present, but naturally enough found only unbelieving ears

"The only one who did not laugh was the Privy Councillor Heuglin, the famous African traveller, and, excepting Brehm, the most celebrated ornithologist of our time for the birds of Africa. I turned to him after the meal, and inquired of his faith The good royal councillor smiled in his caustic way, and with a merry twinkle remarked. 'Let the others laugh they know nothing about it I do not laugh, for the thing is known to me I should have recently made mention of it in my work if I had had any strong personal proof to justify it We must be much more careful in such things than a mere story-teller or novel-writer, we must have a proof for everything. I consider the case probable, but as yet cannot give any warrant for it.'

"My discovery, if I may so call it, I had kept to myself, even after Heuglin had thus expressed himself, and would even now maintain silence on the subject had I not recently discovered a new authority for it."

I read lately in the second edition of Petermann's great book of travels the following —

"Prof. Roth of Munich related to me in Jerusalem that the well known Swedish traveller, Hedenborg, made the following interesting observation on the Island of Rhodes, where he stopped. In the autumn tide, when the storks come in flocks over the sea to Rhodes, he often heard the songs of birds without being able to discover them. Once he followed a flock of storks, and as they lighted he saw small birds fly up from their backs, which in this manner had been borne over the sea The distance prevented him from observing to which species of singing birds they belonged."

Thus wrote the famous geographer Petermann. Prof. Roth and Hedenborg and Heuglin are entirely reliable authors. This was a matter of great curiosity to me, and after I found others had made similar observations and expressed them in print, I thought they would be of no less curiosity and interest on this side of the Atlantic, and equally deserving of public notice. I hope that connoisseurs, amateurs, and experts may be excited by this to extend their observation in this line also The instinct of animals is still, in spite of all our observations and experience,

almost a sealed book to us. By a little attention we might hear of still more curious things in this field PHONE

New York, November 20, 1880

Subsidence of Land caused by Natural Brine-Springs

A THEORY has been put forward to account for the subsidence of land in the salt districts of Cheshire It is said that, supposing the manufacturers of salt ceased to pump up the brine, it would run away to the sea, and subsidence would go on at as rapid a rate as now Can any of the readers of NATURE tell me of any facts to substantiate such a theory, or refer me to any district where such rapid subsidence is going on, owing to the escape of natural brine-springs to the sea? Any reference to works giving information on this point will be thankfully received THOS WARD

Northwich, February 15

Chlorophyll

THE following experiment may be interesting in its bearing on the relation between chlorophyll-development and light.

If cress seed are grown for a few days in the dark on damp cotton wool, and then, beneath the surface of water, introduced into an inverted glass jar filled with water, they may be exposed to daylight for an indefinite time without chlorophyll being developed But the plants are not dead, for if, after a few days' exposure, the cotton wool on which they have been grown is cut in two beneath the surface of the water, and one half, with its plants, is restored to the inverted jar of water, while the other is placed under an inverted glass jar containing air only, and then these two jars be exposed to full daylight, the plants beneath the jar containing air rapidly become green, while the others never do so

Light therefore cannot always cause the development of chlorophyll in the etiolated leaves of living plants

Liverpool, January 24 WILLIAM CARTER

[This is an interesting observation, but seems to need some further investigation As shown by Sachs ("Text-book," pp 665, 666) the formation of chlorophyll has a complicated dependence upon light If the temperature be sufficiently high it is formed in the cotyledons of conifers and the leaves of ferns even in complete darkness The seedlings of angiosperms require exposure to light for the production of chlorophyll, but it does not take place at low temperatures All the visible parts of the spectrum possess the power of turning etiolated grains of chlorophyll green, although the yellow and adjoining rays are most effective. The failure of the seedlings immersed in water to become green can hardly therefore be attributed to the absorption of the heat rays. Is it possible that their water-bath keeps their temperature too low?]

Squirrels Crossing Water

IN NATURE, vol xxiii p 340, I read that Mr Godwin-Austen never had heard of a squirrel taking to the water. As here are perhaps more readers of NATURE in Mr Godwin-Austen's case, I take this opportunity to transcribe what Bachman related to us about that matter in the year 1839

The northern grey and black squirrel *Sciurus leucotis*, has occasionally excited the wonder of the populace by its wandering habits and its singular and long migrations Like the lemming, *Lemmus norvegicus*, of the Eastern Continent, it is stimulated, either from a scarcity of food or from some other inexplicable instinct, to leave its native haunts and seek for adventures or for food in some distant and, to him, unexplored portion of our land. The newspapers from the West contain frequent details of these migrations, they appear to have been more frequent in former years than at the present time The farmers in the Western wilds regard them with sensations which may be compared to the anxious apprehensions of the Eastern nations of the flight of the devouring locust. At such periods, which usually occur in autumn, the squirrels congregate in different districts of the far North-West, and in irregular troops bend their way instinctively in an eastern direction Mountains and cleared fields, the head-waters of lakes and broad rivers, present no unconquerable impediments. Onward they come, devouring on their way everything that is suited to a squirrel's taste, laying waste the corn and wheat-fields of the farmer, and as their numbers are thinned by the gun, the dog, and the club, others are ready to fall in the rear and fill up the ranks, till they occasion infinite mischief and call forth no empty threats of revenge. It is often inquired how these little creatures, that on common occasions have such an instinctive dread of water, are enabled to cross broad and rapid rivers, like the Ohio and Hudson, for instance It is usually asserted, and believed by many, that they carry to the shore a suitable piece of bark, and seizing the opportunity of a favourable breeze, seat themselves upon this substitute for a boat, hoist their broad tails as a sail, and float safely to the opposite shore This, together with many other traits of intelligence ascribed to this species, I suspect to be apocryphal That they do migrate at irregular and occasionally at distant periods is a fact sufficiently established, but in the only instance in which I had an opportunity of witnessing the migrations of the squirrel, it appeared to me that he was not only an unskilful sailor, but a clumsy swimmer It was (as far as my recollection serves me of the period of early life) in the autumn of 1808 or 1809, troops of squirrels suddenly and unexpectedly made their appearance in the neighbourhood, but among the grey ones were varieties not previously seen in those parts, some were broadly striped, with yellow on the sides, and a few with a black stripe on each side, bordered with yellow or brown, resembling the stripes of the little chipping squirrel (*Tamias lysteri*) They swam the Hudson in various places between Waterford and Saratoga, those which I observed crossing the river were swimming deep and awkwardly, their bodies and tails wholly submerged, several that had been drowned were carried downward by the stream, and those which were so fortunate as to reach the opposite bank were so wet and fatigued that the boys stationed there with clubs found no difficulty in securing them alive or in killing them Their migrations on that occasion did not, as far as I could learn, extend farther eastwardly than the mountains of Vermont, many remained in the county of Rensellaer, and it was remarked that for several years afterwards the squirrels were far more numerous than before It is doubtful whether any ever return westwardly; but finding forests and food suited to their tastes and habits, they take up their permanent residence in their newly explored country, there they remain and propagate their species until they are gradually thinned off by the effects of improvement and the dexterity of the sportsmen around them. (The *Magazine of Natural History*, vol. iii, new series, 1839)

Leyden, February 16 F A JENTINK

Flying-Fish

WITH reference to the letter of Mr Pascoe in NATURE, vol xxiii p 312, allow me to offer a suggestion as to the mechanical means by which the flying-fish moves when out of the water During a voyage to India and back I took a great interest in observing the movements of these beautiful creatures by means of a powerful opera glass, and soon came to the conclusion that a slight but rapid tremor of the pectoral fins could be seen for a few moments after the fish left the water In very calm weather I noticed a series of little ripples on each side of the fish as it skimmed along the surface before rising for its flight, evidently caused by the wing-points tipping the water. My idea is that the flying-fish springs from the sea, and by beating the surface rapidly with its pectoral fins obtains an impetus which carries it along for some distance in the air It then descends to the surface, and in the same manner acquires a fresh accession of speed This process however is never repeated more than twice, though the fish does sometimes resume its flight after a moment of immersion R. L. TAYLOR

THE TRANSIT OF VENUS

THE President of the Royal Society presents his compliments to the Editor of NATURE, and will be much obliged to him if he will, at as early a date as may be convenient, be so good as to give publicity to the enclosed minute of the Transit of Venus Committee.

The Royal Society, Burlington House,
London, W., February 21

"THE Committee appointed by the Royal Society, at the request of the Government, to make arrangements for observing the Transit of Venus in 1882, would be glad to be informed whether astronomers have at their disposal, and are willing to lend, for use in the observations, 4-inch, 5-inch, or 6-inch refracting telescopes, and 10-inch or 12-inch reflectors, with equatorial mountings; also portable transits or altazimuths.

"The instruments would be returned, in perfect order, as soon as possible after the transit, and, in any case, before the end of 1883

"All communications should be addressed to the Secretary, Transit Committee, Royal Society, Burlington House"

The Committee, we are informed, is constituted as follows:—The President of the Royal Society is the chairman, the other members being Prof J C Adams, the Astronomer-Royal, the Earl of Crawford and Balcarres, Mr De la Rue, Mr Hind, Dr Huggins, Vice-Admiral Sir G H Richards, Prof. H. J S Smith, Prof Stokes, and Mr E J Stone

DR. J. J. BIGSBY

YET another of the links that have bound the geologists of the present time in association with the early leaders of their science has been severed by the removal of the kindly and venerable form of Dr Bigsby Upwards of sixty years ago he began his geological career in North America, devoting himself mainly to the investigation of the structure of the older Palæozoic rocks of Canada and of the adjoining tracts of the States As ...tary to the Boundary Commission under the Treaty of Ghent he had opportunities of investigating the region from Quebec to Lake Superior, and published numerous descriptions, of which the exactness has been amply verified by the subsequent researches of the Geological Survey of Canada It is chiefly as an admirable pioneer in Canadian geology that his name will be inscribed in the records of scientific progress But he has other claims to grateful remembrance Since he returned to spend his later years in this country he has devoted himself with the most untiring patience to the compilation of his "Thesaurus Siluricus" and "Thesaurus Devonicus"-works in which the geological and geographical range of the organisms of the earlier half of Palæozoic time is clearly shown in a series of valuable tables

Still more recently, in 1877, he presented to the Geological Society a bronze medal which, with a sum of money derived from the interest of a fund also given by him, is to be awarded every two years as an incentive to geological study The terms according to which he directed that the prize should be given are that the medal and interest from the fund should be awarded "as an acknowledgment of eminent services in any department of geology, irrespective of the receiver's country, but he must not be older than forty-five years at his last birthday, thus probably not too old for further work, and not too young to have done much" The founder lived to see two fitting awards of his prize go to the eminent palæontologists of the United States, Professors O C Marsh and E. D Cope He died just before the third presentation was made, last week, to Dr Charles Barrois of Lille.

ON TIDAL FRICTION IN CONNECTION WITH THE HISTORY OF THE SOLAR SYSTEM[1]

THIS paper forms one of a series on the subject of tidal friction which have been read from time to time before the Royal Society and reported in NATURE.

The first part of the paper contains the investigation of the changes produced by tidal friction in the system formed by a planet with any number of satellites revolving about it in circular orbits As the results cannot be conveniently stated without the aid of mathematical notation, they are here passed over

The previous papers treated of the effects which tidal friction must have had on the motions of the earth and moon, on the supposition that time enough has elapsed for this cause to have its full effect It then appeared that we are thus able to co-ordinate together the various elements of the motions of these two bodies in a manner too remarkable to be the product of chance

The second part of the present paper contains a discussion of the part which the same agency may have played in the evolution of the solar system as a whole and of its several parts

It is first proved that the rate of expansion of the planetary orbits, due to the reaction of the frictional tides raised by the planets in the sun must be very slow compared with that due to the reaction of the tides raised by the sun in the planets Thus it would be much more nearly correct to treat the sun as a rigid body, and to suppose the planets alone to be subject to frictional tides, than the converse It did not, however, seem expedient to attempt to give any numerical solution of the problem thus suggested which should apply to the solar system as a whole

The effect of tidal friction is to convert the rotational momentum of the tidally disturbed body into orbital momentum of the tide-raising body Hence a numerical evaluation of the angular of the solar system will afford the means of forming some idea of the amount of change in the orbits of the several planets and satellites, which may have been produced by tidal friction Such an evaluation is accordingly made in this paper, with as much accuracy as the data permit

From the numerical values so found it is concluded that the orbits of the planets round the sun can hardly have undergone a sensible enlargement from the effects of tidal friction since those bodies first attained a separate existence.

Turning to the several sub-systems, it appears that, although it is possible that the orbits of the satellites of Mars, Jupiter, and Saturn about their planets may have been considerably enlarged, yet it is certainly not possible to trace the satellites back to an origin almost in contact with the present surfaces of their planets, in the same manner as was done for the case of the moon in the previous papers

The numerical values above referred to exhibit so marked a contrast between the case of the earth with the moon, and that of the other planets with their satellites, that it might *à priori* be concluded as probable that the modes of evolution have differed considerably. The conclusion above stated concerning the satellites of the other planets cannot therefore be regarded as unfavourable to the acceptance of the views maintained in the previous papers It must, however, be supposed that some important cause of change other than tidal friction has been concerned in the evolution of the solar system and the planetary sub-systems According to the nebular hypothesis of Laplace, that cause has been the condensation of the heavenly bodies Accepting that hypothesis, the author then proceeds to consider the manner in which contraction and tidal friction are likely to have worked together

A numerical comparison shows that, notwithstanding the greater age which the nebular theory assigns to the exterior planets, yet the effects of solar tidal friction in reducing planetary rotation must in all probability be considerably less for the remote than for the nearer planets It is, however, remarkable that the number expressive of the rate of retardation of the Martian rotation by solar tidal friction is nearly the same as the similar number for the earth, notwithstanding the greater distance of Mars from the sun This result is worthy of notice in connection with the fact that the inner satellite of Mars revolves with a periodic time much shorter than that of the planet's rotation, for (as suggested in a previous paper) solar tidal friction will have been com-

[1] An account of a paper entitled "On the Tidal Friction of a Planet attended by several Satellites, and on the Evolution of the Solar System," by G. H. Darwin, F.R.S., read before the Royal Society on January 20, 1881

petent to reduce the planetary rotation without directly affecting the satellite's orbital motion

It is then shown to be probable that solar tidal friction was a more important cause of change when the planets were less condensed than it is at present Thus we are not to accept the present rate of action of solar tidal friction as indicating that which has held true in all past time.

It is also shown that if a planetary mass generates a large satellite, the planetary rotation is reduced after the change more rapidly than before, nevertheless the genesis of such a satellite is preservative of the moment of momentum which is internal to the planetary sub-system. This conclusion is illustrated by the comparatively slow rotation of the earth, and by the large amount of angular momentum residing in the system of moon and earth

An examination of the manner in which the difference of distances of the various planets from the sun will have affected the action of tidal friction leads to a cause for the observed distribution of satellites in the solar system

According to the nebular hypothesis a planetary mass contracts, and rotates quicker as it contracts The rapidity of the revolution causes its form to become unstable, or perhaps, as seems more probable, an equatorial belt gradually detaches itself, it is immaterial which of these really takes place In either case the separation of that part of the mass which before the change had the greatest angular momentum permits the central portion to resume a planetary shape The contraction and increase of rotation proceed continually until another portion is detached, and so on There thus recur at intervals a series of epochs of instability or of abnormal change

Now tidal friction must diminish the rate of increase of rotation due to contraction, and therefore if tidal friction and contraction are at work together the epochs of instability must recur more rarely than if contraction acted alone

If the tidal retardation is sufficiently great, the increase of rotation due to contraction will be so far counteracted as never to permit an epoch of instability to occur

Now the rate of solar tidal friction decreases rapidly as we recede from the sun, and therefore these considerations accord with what we observe in the solar system For Mercury and Venus have no satellites, and there is a progressive increase in the number of satellites as we recede from the sun

Whether this be the true cause of the observed distribution of satellites amongst the planets or not, it is remarkable that the same cause also affords an explanation of that difference between the earth with the moon and the other planets with their satellites, which has permitted tidal friction to be the principal agent of change with the former, but not with the latter.

In the case of the contracting terrestrial mass we may suppose that there was for a long time nearly a balance between the retardation due to solar tidal friction and the acceleration due to contraction, and that it was not until the planetary mass had contracted to nearly its present dimensions that an epoch of instability could occur.

If the contraction of the planetary mass be almost completed before the genesis of the satellite, tidal friction, due jointly to the satellite and the sun, will thereafter be the great cause of change in the system, and thus the hypothesis that it is the sole cause of change will give an approximately accurate explanation of the motion of the planet and satellite at any subsequent time. It is shown in the previous papers of this series that this condition is fulfilled with the earth and moon

The paper ends with a short recapitulation of those facts in the solar system which are susceptible of explanation by the theory of the activity of tidal friction This series of investigations affords no grounds for the rejection of the nebular hypothesis, but while it presents evidence in favour of the main outlines of that theory, it introduces modifications of considerable importance

Tidal friction is a cause of change of which Laplace's theory took no account, and although the activity of that cause is to be regarded as mainly belonging to a later period than the events described in the nebular hypothesis, yet its influence has been of great, and in one instance of even paramount, importance in determining the present condition of the planets and their satellites

G H D.

INDIGO

In July, 1878, an account was given in this journal of the synthesis of indigo-blue from phenylacetic acid, accomplished by Prof Baeyer of Munich (NATURE, xviii. 251). The process there described did not permit of the successful production of indigo-blue on a manufacturing scale at reasonable cost. Since that time Prof Baeyer has continued to work at the problem, and he has so far succeeded that he has now taken out a patent for the artificial manufacture and application of indigo-blue

In a paper in the last number of the *Berliner Berichte* Baeyer gives an interesting *résumé* of the steps whereby progress has been slowly made, since 1865, in solving the problem of the synthesis of indigo

Following up the work sketched in the article already referred to, Baeyer attempted to prepare *orthonitrophenyl acetic aldehyde*, expecting that this substance would yield indol, which may be regarded as the parent substance of the indigo group of compounds. But as the work proceeded Baeyer became more and more convinced that the hypothesis which had guided his earlier work was that which should still regulate his experiments In 1869 he had written, "In order to prepare indol synthetically it is necessary—in accordance with the formula already given—to introduce a pair of carbon atoms and one nitrogen atom into benzene, and to link these together. The necessary conditions are found in *nitro-cinnamic acid*, if one supposes carbon dioxide and the oxygen of the nitro-group to be removed. And indeed it has been shown that nitro-cinnamic acid yields indol by fusion with potash" The steps in the preparation of indigo-blue, according to Baeyer's patent, are these.—

1 *Cinnamic acid* (or *phenyl acrylic acid*)—

$$C_6H_5\ C_2H_2\ CO_2H.$$

2 *Orthonitrocinnamic acid*—

$$C_6H_4\langle{}^{NO_2}_{C_2H_2\ CO_2H.}$$

3 *Orthonitrocinnamic acid dibromide*—

$$C_6H_4\langle{}^{NO_2}_{C_2H_2Br_2\ CO_2H\ ,}$$

prepared by acting on No 2 with gaseous bromine and crystallising from benzene.

The dibromide in alcoholic solution is then treated with alcoholic potash, in the proportion of 1 . 2 molecules, and after dilution with water

4 *Orthonitromonobromcinnamic acid*—

$$C_6H_4\langle{}^{NO_2}_{C_2HBr.\,CO_2H,}$$

is precipitated By again treating this acid with three molecules of alcoholic potash

5 *Orthonitrophenylpropiolic acid*—

$$C_6H_4\langle{}^{NO_2}_{C_2.\,CO_2H}$$

is produced When an aqueous solution of this acid is warmed with such feeble reducing agents as grape- or milk-sugar, in presence of caustic or carbonated alkali, indigo-blue separates in crystals. It is not however

necessary to prepare pure orthonitrophenylpropiolic acid, if orthonitrocinnamic acid (No 2 above) be treated with bromine, then with alcoholic potash, and lastly with grape-sugar, without separating the various products indigo-blue is produced. Orthonitrocinnamic acid may be prepared, without difficulty, from oil of bitter almonds

Artificial indigo may be directly printed on cloth by mixing orthonitrophenylpropiolic acid—or *orthonitrophenyloxyacrylic acid* described below -with soda and grape- or milk-sugar, and after proper thickening, soaking the cloth in the mixture, and heating or the material may be simply soaked in orthonitrophenyloxyacrylic acid and heated

Orthonitrophenyloxyacrylic acid is prepared by the action of alcoholic potash on an alcoholic solution of orthonitrophenylchlorolactic acid (itself prepared by the action of chlorine on orthonitrocinnamic acid), in accordance with the equation—

$$C_6H_4\left\langle\begin{matrix}NO_2\\ C_2H_3OCl\,.\,CO_2H\end{matrix}\right. + 2KOH =$$
$$C_6H_4\left\langle\begin{matrix}NO_2\\ C_2H_2O\,.\,CO_2K\end{matrix}\right. + KCl + H_2O$$

By boiling an aqueous solution of orthonitrocinnamic acid dibromide (No 3 above) with sodium carbonate, indigo blue separates out M. M. P M.

MICROSCOPIC STRUCTURE OF MALLEABLE METALS

THE following observations on the minute structure of metals, which have been hammered into thin leaves, are instructive Notwithstanding the great opacity of metals, it is quite possible to procure, by chemical means, metallic leaves sufficiently thin to examine beneath the microscope by transmitted light Silver leaf, for instance, when mounted upon a glass slip and immersed for a short time in a solution of potassium cyanide, perchloride of iron, or iron-alum, becomes reduced in thickness to any required extent The structure of silver leaf may also be conveniently examined by converting it into a transparent salt by the action upon it of chlorine, iodine, or bromine Similar suitable means may also be found for rendering more or less transparent most of the other metals which can be obtained in leaf

An examination of such metallic sections will show two principal types of structure, one being essentially granular, and the other fibrous

The granular metals, of which tin may be taken as an example, present the appearance of exceedingly minute grains, each one being perfectly isolated from its neighbours by still smaller interspaces The cohesion of such leaves is very small

The fibrous metals, on the other hand, such as silver and gold, have a very marked structure Silver, especially, has the appearance of a mass of fine, elongated fibres, which are matted and interlaced in a manner which very much resembles hair. In gold this fibrous structure, although present, is far less marked The influence of extreme pressure upon gold and silver seems to be, therefore, to develop a definite internal structure. Gold and silver in fact appear to behave in some respects like plastic bodies. When forced to spread out in the direction of least resistance their molecules do not move uniformly, but neighbouring molecules, having different velocities, glide over one another, causing a pronounced arrangement of particles in straight lines.

This development of a fibrous structure, by means of pressure, in a homogeneous substance like silver, is an interesting lesson in experimental geology, which may serve to illustrate the probable origin of the fibrous structure of the comparatively homogeneous limestones of the Pyrenees, Scotland, and the Tyrol

J. VINCENT ELSDEN

ISLAND LIFE [1]

II

IN the second half of his volume Mr Wallace proceeds to apply to the elucidation of the history of the characteristic assemblages of plants and animals in islands, the principles laid down with so much explicitness in the first half He points out that for the purposes of the naturalist a fundamental difference exists between islands that have once formed part of continents and those which have not Continental islands are those which, by geological revolutions at more or less remote periods, have been severed from the continental masses in their neighbourhood. They are recognisably portions of the continental ridges of the earth's surface This relation is usually made strikingly apparent by the chart of soundings between them and the nearest mainland (Fig 2) Further, in geological structure they resemble parts of the continents, like which they contain both old and new formations, with or without volcanic accumulations In some cases the evidence of recent severance from the adjacent continent is abundant In others it is less distinct, for example, where the islands are separated from the nearest land by a depression of a thousand fathoms or more, and where their fauna, though abundant, is of a fragmentary nature, almost all the species being distinct, many of them forming distinct and peculiar genera or families, while many of the characteristic continental orders or families are entirely absent, and in their place come animals to which the nearest allies are to be found only in remote parts of the world Oceanic islands, on the other hand, exhibit no geological connection with any continental area, but owe their birth either to upheaval of the ocean floor or to the piling up of lavas and tuffs round submarine vents of eruption Their geological structure is of the simplest kind As Mr Darwin long ago showed, they consist of volcanic rocks or of coral reefs, or of volcanic and coralline formations combined Ancient formations, so characteristic of continental islands, are wholly wanting These islands lie far removed from a continent, and rise from water of profound depth Their fauna is in curious keeping with this isolation, for it contains no indigenous land-mammals or amphibians, but abounds in birds and insects, and usually possesses some reptiles These animals or their ancestors must have reached the islands by crossing the ocean

Mr Wallace first attacks the problems presented by the Oceanic Islands (Fig 1) He describes the characters of the flora and fauna of the Azores, Bermuda, the Galapagos, St Helena, and the Sandwich Islands, and endeavours in each case to show how the resemblances and differences between them and the plants and animals of the continents may be accounted for The contrast offered by two groups of islands on either side of the American continent—the Bermudas and Galapagos—brings vividly before the mind the nature of the difficulties with which the author grapples, and the methods by which he seeks to solve them In the case of the Bermuda group a series of coral islets having a total area of no more than fifty square miles rises from the very deepest depression in the Atlantic basin in 32° N lat. at a distance of 700 miles from North Carolina The chief elements in the fauna of these islands are birds and land-shells Upwards of 180 species of birds have been observed, more than half of which belong to wading and swimming orders, while eighty-five are land-birds, of which twenty species are frequent visitors Only ten species live as permanent residents on the island, and these are all common North American birds No bird, and indeed no vertebrate animal, save a species of lizard, is peculiar to Bermuda. The feathered population of the islands is de-

[1] "Island Life, or, the Phenomena and Causes of Insular Faunas and Floras," &c By Alfred Russel Wallace (London, Macmillan and Co, 1880) Continued from p 359

rived from the North American continent, whence every year, especially during the autumnal storms, numbers of birds are blown out to sea. Most of these no doubt perish, but some succeed in reaching Bermuda Hence from this constant introduction of fresh individuals there has been no development even of any distinct variety in the avian fauna. The land-shells include twenty species, of which at least four, or about a fourth of the whole, are peculiar. The proportion of peculiar land-shells among the Azores is about a half of the whole number of resident species It is obvious that these organisms have comparatively feeble and uncertain means of transport as compared with birds. They may be carried only at widely separated and irregular intervals, enclosed in drift-wood from some other island or continent Hence the conditions for their gradual change under the new circumstances of their insular home are exceptionally favourable The flora of Bermuda contains a majority of tropical and West Indian plants, and includes a number of species identical with

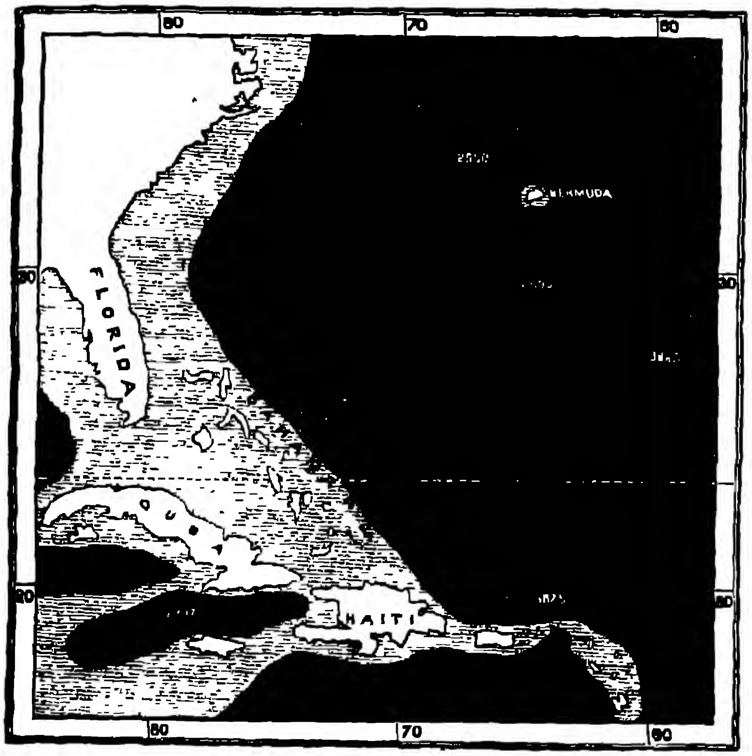


FIG 1 —Map of Bermuda and the American Coast The darker tint indicates sea more than 1000 fathoms deep, the lighter shows sea less than 1000 fathoms The figures mark the depth in fathoms

those in the Southern States of the American Union. The origin of this vegetation is thus easily traced, first, to the operation of marine currents, whereby plants of the West Indian Islands have been actually observed to be washed ashore on Bermuda and to germinate there, next, of cyclones by which fine seeds transported in the higher parts of the atmosphere may doubtless be easily carried from the American continent; and thirdly, of birds, which among their feathers and in the mud adhering to their feet are known to transport living seeds to enormous distances.

The Galapagos, though less distant from the west side of the American continent than the Bermudas are from the east side, rise nevertheless out of a profoundly deep ocean. The whole group of seventeen islands ranges over an area of 300 miles in length by 200 in breadth, being of volcanic origin, and still containing in the western islands numerous active volcanoes. Between the fauna of the Galapagos however and that of the nearest part of South America a remarkable difference obtains. As usual, no indigenous mammalia or amphibia occur in these islands, but a few species of reptiles abound—land-tortoises, lizards, and snakes, that find their nearest allies on the American continent, whence doubtless their ancestors at some remote period were derived. Out of a total of fifty-seven species of birds no fewer than thirty-eight are peculiar In particular the land-birds number thirty-one species, which are all, with but one exception, confined to the Galapagos, and more than half of them are so peculiar as to be ranked in distinct genera, though all are undoubtedly allied to birds inhabiting Tropical America. Mr Wallace points out that every gradation can be traced, from perfect identity with continental species to marked generic divergence, and that "this diversity bears a distinct relation to the probabilities of and facilities for migration to the islands." A species which is widely diffused and essentially migratory will, by frequent arrival of fresh individuals from the parent stock and intercrossing, continue unchanged, while others, in proportion to the rarity of their re-introduction, will be subject to all the variation which change of habitat and prolonged isolation may induce. The flora of these islands includes 174 peculiar flowering-plants, and 158 common to other regions. Among the latter occur forms found both in North and South America, with some that range into the West Indies Sir Joseph Hooker has observed that the peculiar plants of the Galapagos are allied to forms now found in temperate America, or in the high Andes, while the non-peculiar species are such as live in tropical latitudes near the sea-level. These facts in zoological and botanical distribution the author seeks to explain by the meteorological conditions and geological history of the region The Galapagos Islands lie in a tract of almost perpetual calms The storms that annually transport a fresh immigration of birds and seeds to the Bermudas are there unknown; consequently the fauna and flora present a far greater contrast to those of the continent than is the case of Bermuda The presence of West Indian species is regarded as pointing to the former submergence of the Isthmus of Panama and the consequent drifting of those forms from the north-east, perhaps by a deflected branch of the Gulf Stream Again, the affinity of a portion of the Galapagos flora to plants of northern or sub-alpine types is looked upon as an indication of that ancient southward migration of northern forms consequent upon the extension of the snow and ice of the Glacial Period.

As examples of Continental Islands the author describes the British Isles, Borneo, Java, Japan, Formosa, and the Madagascar group The difference between the plants and animals of continental islands and those of the neighbouring continents varies extensively, one main effective element in the case being the length of time during which insular relations have been established. Taking Britain as perhaps the most typical illustration of a large and recently separated continental island (Fig. 2), Mr. Wallace points out how many are the proofs of comparatively recent subsidence, which he regards as the cause of the severance of Britain from the continent Undoubtedly subsidence was one, probably the principal,

operation whereby the British Islands were isolated We must not forget however that denudation also played its part. The excavation of the Strait of Dover, for example, may have been in large measure effected by streams diverging from the watershed and partly by the littoral erosion of the waves as they advanced upon the slowly foundering land. The recent date of the separation of Britain is shown by the identity of the fauna as a whole with that of France and Germany But as compared with the continent, the British Isles are remarkably poor in species In Germany, for example, there are nearly ninety species of land mammals, even Scandinavia possesses about sixty, but Britain can boast only forty—a number which in Ireland is reduced to twenty-two Still more remarkable is the contrast presented by the reptiles and amphibia, for while Belgium possesses twenty-two species, Britain can show no more than thirteen, and Ireland has only four. This progressive diminution of the fauna westward is even illustrated by animals possessing the power of flight, though, as might be supposed, it is in these cases less strongly marked The twelve bats of Britain are reduced to seven in Ireland, the 130 land-birds to about 110 In Britain 1425 species of flowering plants and ferns are known, but in Ireland only 970, or two-thirds of the British flora The reason assigned by Mr Wallace for this poverty of species is the extensive submergence of the British Islands during the later stages of the Glacial Period He believes that the interval between the subsequent elevation and the final separation of Britain from the continent cannot have been of long duration It was indeed sufficiently prolonged to allow of the migration westwards of a considerable part of the Post-glacial fauna and flora, but the insular condition was established before more than a part had succeeded in reaching Britain, where both the soil and climate would have been eminently favourable for the reception of the rest The time that has elapsed since our area ceased to be continental has been long enough for the production of a few peculiar varieties No distinct species or variety of mammal, reptile, or amphibian has arisen But we possess three peculiar birds—the coal-tit, long-tailed tit, and grouse—fifteen peculiar species of fresh-water fishes, sixty-nine lepidopterous insects, seventy-two beetles, four caddis-flies, and four terrestrial and fluviatile shells believed to be peculiar In the flora the chief contrasts are exhibited by the mosses and hepaticæ, of which respectively seventeen and nine forms appear to be peculiar This mode of considering the British fauna and flora brings out in clear relief the relations between them and those of the continent, and their bearings upon the question of the origin of peculiar forms. Not only do the British Islands as a whole contain species or varieties that do not appear on the mainland of Europe, but some of our outlying islands, such as the Shetland Isles, the Isle of Man, and Lundy Island, possess each its local forms that are not met with on the main island.

As "anomalous islands" the author classes together Celebes and New Zealand, the former because it belongs to no one of the six zoological regions of the globe, and cannot be certainly affirmed to have been united to a continent, the latter because in some respects it may be regarded as an oceanic, in others as a continental island Celebes is supposed by Mr. Wallace to be probably a fragment of Miocene Asia, preserving down to the present time a few remnants of its Tertiary fauna, together with an intermixture of more modern types that have been introduced by ordinary means of dispersal Three interesting chapters are devoted to New Zealand, and in these is discussed the important question of the origin of the European element in the floras of the temperate southern latitudes

Enough has been said here to show the nature and value of this new contribution to scientific literature. Even where Mr. Wallace's conclusions may be disputed, they are always of the most suggestive kind His volume, as he acknowledges, is the development and application of a theory, but it is not written in the spirit of a mere partisan Its facts are of course marshalled in such form as most effectively to sustain the theory, yet with a transparent directness and honesty of purpose that runs through the whole book, and gives it one of its great charms. The writer does not consciously shut his eyes to any of the difficulties of his case Candidly admitting them, he presents such explanation as seems to him to offer the most likely pathway to their ultimate solution.

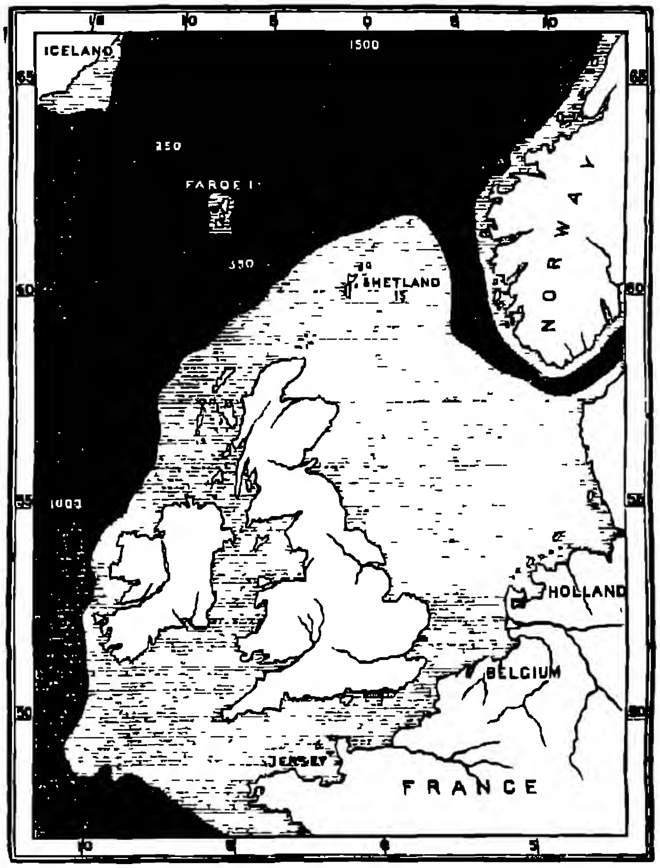


FIG 2—Map of the shallow bank connecting the British Isles with the Continent The dark tint marks sea of more than, the paler tint shows sea of less than, 1000 fathoms in depth The figures show the depth in fathoms The narrow channel between Norway and Denmark is 2580 feet deep

He deserves the thanks alike of geologists and of biologists for a treatise, the appearance of which marks another epoch in the history of the doctrine of Evolution

ARCH GEIKIE

HONOUR TO MR DARWIN

THE following address to Mr Darwin, from New Zealand, speaks for itself —

To Charles Darwin, Esq

SIR,—We, the members of the Council of the Otago Institute, beg to offer you our congratulations on this, the

twenty-first anniversary of the publication of your great work, the "Origin of Species."

However limited the field of our own labours may be, we cannot but be sensible of the influence which that work has had throughout the whole domain of Natural Science, and especially upon Biology, which, as one great comprehensive Science, may be said to owe its very existence to the fact that you made belief in Evolution possible by your theory of Natural Selection

We are glad to think that you have lived to see the almost universal acceptance of the great doctrine which it has been the work of your life to establish; it is hardly an exaggeration to say that every important Botanical or Zoological discovery of the last twenty-one years, particularly in the departments of Embryology and Palæontology, has tended to fill up some gap in the evidence you had originally collected, and to make Evolution no longer a theory, but an established doctrine of Science.

We hope that you may long live to continue your labours and to see the further spread of their influence upon all scientific thought and upon all higher scientific work

We are, sir, your obedient servants,

THOS MORGAN HOCKER	*President*
F. W. HUTTON	*Vice-Presidents*
GEORGE H F ULRICH	*Vice-Presidents*
GEORGE M THOMSON	*Hon. Sec.*
HENRY SKEY	*Hon Treasurer*
ROBERT GILLIES	*Members of Council*
C. W. BLAIR	*Members of Council*
ALEXANDER MONTGOMERY	*Members of Council*
T JEFFERY PARKER	*Members of Council*
W. MACDONALD	*Members of Council*
DONALD PETRIE	*Members of Council*

Dunedin, New Zealand, October 1, 1880.

DEGREES TO WOMEN

WE trust the Grace which is to-day to be submitted to the Cambridge Senate, advocating the admission of women to receive University degrees, will meet with the approval of that body In fact, as the *Times* put it yesterday, the point was ruled ten years ago "Cambridge, in conniving at its public examiners examining Girton and Newnham students precisely as if they were Trinity or Johnian scholars, gave in spirit what is now demanded It seems ungenerous, and not very rational, for a university to let its authorities proclaim a man in the Senate House eighth wrangler, and inform Girton College that the real eighth wrangler was a woman Even a country clerical passman would not venture to withdraw the existing licence; all that remains is for the Senate to ratify with a good grace the principle upon which its officials have long and openly been acting"

The following paper, which has been issued from Cambridge in view of to-day's discussion, puts the case as fairly as it can be put.—

Reasons why the university should be one of the leading centres of female education.

1. Because no line can be drawn separating main subjects of study or whole branches of learning into those suitable for men and unsuitable for women, or *vice versâ* No true classification of human knowledge will admit of the distinction, "Propria quæ maribus tribuuntur, mascula dicas." 2. Because the University as a chief inheritor and transmitter of learning from generation to generation has no right to dissociate itself from any great movement connected with the advancement of learning The participation of women in the general and particularly in the higher studies of their time must be a great fact and factor in the future of education. 3. Because whatever educational resources may be found elsewhere, those of Cambridge and Oxford are peculiar; and though as long as there was no public demand for these resources except from male students they were properly applied only to male education, now that a demand has sprung up and persistently declared itself on the part of the other sex, the university will incur the reproach of inhospitable partiality if it bars its doors, like a monastery, to female applicants for admission. 4 Because one of the legitimate wants and aspirations of the University—leisure for continued study and research—is likely to be promoted by increasing the amount of remunerative educational work done in the university. The more work, the more workers, and the more remuneration, and out of work, workers, and earnings, the legitimate and sure outcome will be leisure for the worthiest work and workers. 5. Because the education of women in England must, from irresistible national feelings and convictions, be religious and Christian, and if female education is centred in the university a stimulus will be given to the best religious influences in study and life; and from these the English universities have never for any long period been dissociated 6. Because any mischievous consequences that might be feared, whether to the university or to the students, by the admission of women can be guarded against by suitable regulations, and still more by responsible authorities, whereas the diversion of the interests and influences that are gathering round the question of women's education from the university to other centres would be an irretrievable step, isolating the university for the future from a movement of great force and promise. J L. BRERETON

February 16

NOTES

AT the anniversary meeting of the Royal Astronomical Society, on the 11th inst., Mr Hind, president, in the chair, the gold medal was presented to Prof. Axel Moller, Director of the Observatory at Lund, in Sweden, for his investigations on the motion of Faye's comet Prof Moller's researches commenced in 1860, soon after attention had been directed to this comet by the offer of a prize for the accurate determination of its orbit by the Society of Natural Sciences of Dantzic, and they have been continued to the present time, the comet's track at each of the three subsequent returns in 1865 66, 1873, and 1880-81, having been predicted with a precision which has excited in no small degree the admiration of astronomers, indeed, at the re-appearance in 1873, M Stephan's first observation at the Observatory of Marseilles, showed that the error of predicted place was less than *six seconds of arc*, and after the last revolution, when the perturbations from the action of the planets were greater than in any previous revolution since the comet was first detected by M Faye in 1843, the agreement between observation and calculation was still very close. One important result of these investigations has been a striking confirmation, from the motion of Faye's comet, of the value for the mass of Jupiter deduced by Bessel from the elongations of the satellites, the two values according within the limits of their probable errors Prof. Moller also carried back the accurate computation of the perturbations to December, 1838, so as to ascertain the effect of a pretty near approach to Jupiter in March, 1841, upon the previous orbit, and having done this he examined the probable circumstances of a very near approach of the two bodies near the passage of the node in 1816, to which attention had been drawn by Valz soon after the comet's orbit was fairly determined Thus Moller's laborious investigations extend over a period of forty-three years, during which he has followed the motion of the comet with all the refinements of which the actual state of the science admits. It will be generally accorded that the medal has been well earned in Prof Moller's case The last occasion on which it was awarded for investigations of a similar kind was as far back as 1837, when the Astronomer-Royal presented the medal to Rosenberger for his researches on the motion of Halley's comet.

AT the anniversary of the Geological Society on Friday the medals were awarded as follows:—The Wollaston medal to Prof P. Martin Duncan, M B, F.R S., F.G S; the Murchison medal to Prof Archibald Geikie, F R.S., F G S; the Lyell medal to Principal Dawson, LL D, F.R.S., F G S., of McGill College, Montreal, and the Bigsby medal to Dr. Charles Barrois of Lille. The Wollaston Fund was awarded to Dr. R H

Traquair, F.G.S., of Edinburgh, the Murchison fund to Frank Rutley, F.G.S.; the Lyell Fund in equal parts to G. R. Vines of Sheffield, and to Dr. Anton Fritsch of Prague.

IN addition to the amount reported last week, we have received two guineas from Mr. William Black for the John Duncan Fund, making the total received through NATURE £67 4*s.* 3*d.*

THE first of Prof. Flower's nine lectures on the Anatomy, Physiology, and Zoology of the Cetacea, in the theatre of the College of Surgeons, will be given on Monday next. The Comparative Anatomy of Man, which formed the subject of the last four courses of lectures, is far from being exhausted, especially as the acquisition of the Barnard Davis collection has more than doubled the materials at the disposal of the lecturer for its illustration. But the work of removing, cleaning, arranging, and cataloguing the numerous specimens of this collection has absorbed so much time, that little has been left as yet for their scientific examination. As any attempt at exposition of the variations of the osteological structure of man, from which the evidence afforded by the newly-acquired specimens is omitted, would be very incomplete, it has been thought advisable to postpone the continuation of the subject to a future time. The anatomy of the group selected for consideration this year is of great interest, and particularly well illustrated in the Museum, (as it is a subject to which John Hunter devoted much attention, and upon which he published a valuable memoir in the *Philosophical Transactions* for 1787, entitled "Observations on the Structure and Œconomy of Whales") —General characters of the Cetacea, Division into two distinct groups—*Mystacoceti* or whalebone-whales, and *Odontoceti* or tooth whales, Anatomy of the lesser rorqual (*Balænoptera rostrata*) as a type of the *Mystacoceti*, Other whalebone-whales—rorquals (*Balænoptera*), humpbacks (*Megaptera*), and right whales (*Balæna*), Anatomy of the porpoise (*Phocæna communis*) as a type of the *Odontoceti*, Other toothed whales—*Delphinidæ*, dolphins, beluga, narwhal, platanista, &c.; *Physeteridæ*—sperm-whale and its allies, Extinct Cetacea—position of the order in the animal kingdom, and relation to other groups.

WE regret that the Lords should have thrown out the Bill on Tuesday for the Opening of Museums and similar places on Sundays. The smallness of the majority leads us to hope that this forward and really beneficial step will be taken ere very long. As the *Times* very well puts it:—"The gravity of the question is that London has in its midst people to whom anything of the nature of intellectual toil—and prolonged sight-seeing is of that character—is essentially irksome. But they are human beings, and not lost to all salutary influences. It would be folly to despair of making the Sunday more tolerable than it is to them. Our climate does not often admit of men and women sitting out of doors talking or listening to elevating music. Some substitute must be found to put us on equality with the people of more sunny lands. It is the task of true friends of the working classes to suggest means by which, without any revolution in national ideas as to the sacredness of Sunday, they may be enabled to taste those simple and primitive pleasures—for example, the pleasure of pure repose of mind and body, or that of hearing music—which all, even the untutored, can enjoy. The movement is directed towards the cure of a real social evil, and those who oppose it are bound to suggest a more effectual remedy."

BY an oversight, for which the American authorities must be held partly responsible, we did not observe that the volume on "Odontornithes," by Prof. Marsh, briefly alluded to in NATURE of last week, was the same work which had already been reviewed in our columns as far back as September 16 of last year (vol. xxii. p. 457). The monograph now sent to us bears no reference to the previous issue of the same work. It is announced as a portion of the Survey of the Fortieth Parallel under Mr. Clarence King; but no number is assigned to it as a volume of that splendid series of quartos. We hope that this new issue of the work will secure for it a still wider circle of readers, as it certainly adds additional lustre to the Survey of the Fortieth Parallel.

THE Hunterian Oration this year was so far original that the orator, Mr. Luther Holden, gave the results of some original research he has been making into the early life of John Hunter. It is usually said that Hunter, up to the time of his coming to London, led a completely idle life, giving no promise whatever of future eminence. Dr. Holden however thinks he has proved that Hunter, instead of being apprenticed to a cabinet-maker, entered Glasgow University when he was seventeen years old, and had the advantage of a regular training under the eye of Cullen. Whatever may be thought of the evidence Mr. Holden adduced, he has certainly opened fresh ground, quite deserving to be worked out by future orators.

THE freedom of the Cutlers' Company was conferred upon Sir Henry Bessemer last week. At the dinner which followed he stated that a young and rising American "city" had been named after him.

CAN any reader send us information concerning the fate of the instruments which belonged to the late Dr. Dick of Broughty Ferry, Scotland, the author of a number of theologico-scientific works ("Philosophy of a Future State," &c.), rather remarkable for their advanced views, considering the time at which they were published—about forty years ago? He is said to have left, among other things, a large telescope, the subsequent history and present possessor of which we are anxious to trace.

THE Commissariat-General of the Paris International Exhibition of Electricity are anxious that all requests for space be sent in as soon as possible, and not later than March 31.

THE following are prize-subjects lately proposed by the Society of Arts and Sciences at Utrecht:—Researches on the development of one or several invertebrate species of animals whose history is not yet known; exact anatomical description of the larva and nymph of the common cockchafer (*Melolontha vulgaris*), means of purifying the rivers of Holland so as to render them potable, and expense of application on a large scale; results of experiments in recent times as to the movement of liquids and the resistance they offer to moving bodies, study of the theories of electric phenomena in muscles and nerves, critical *aperçu* of the methods for determining the place occupied in bodies of the aromatic series by substituted atoms and groups of atoms (according to Kekule and Ladenburg's theory regarding benzol), quantities of heat liberated or absorbed in the allotropic change of two or several simple substances; heat given by the moon in different phases. Papers may be written in French, Dutch, German, English, or Latin, and must be sent to the Secretary, Baron R. Melvil, of Lynden, before December 1, 1881. The prize is a diploma of honour and 300 Dutch florins.

A CLASSIFIED list of the books published in Germany during 1880, just issued by Hinrichs of Leipzig, shows the number of publications to be steadily increasing. We find a total of 14,941 new works against 14,179 in 1879. The largest number belongs to the class of school-books and other works for the young, viz., 2446 (against 2175 in 1879). We give the further classes in a descending scale, adding the numbers for 1879:—Law, politics, statistics, conveyancing, 1557 (1683), theology, 1390 (1304); Belles Lettres, 1209 (1170); medicine, 790 (732), natural history, chemistry, pharmacy, 787 (841), historical works, 752

(680), popular works, almanacs, 657 (642), fine arts, stenography, 627 (584); commerce, 583 (577), classical and oriental languages, archæology, mythology, 533 (481), modern languages, old German literature, 506 (485), agriculture, 433 (421), miscellaneous writings, 423 (378), architecture, railways, engineering, mines, and navigation, 403 (384), bibliography, encyclopædias, 377 (276), geography, travels, 356 (306), war, 353 (337), maps, 301 (300), mathematics, astronomy, 201 (158), philosophy, 125 (139), forests and game, 112 (103), freemasonry, 20 (21)

MESSRS MACMILLAN AND CO have in preparation, and will publish this year, "A Course of Instruction in Zootomy (Vertebrata)," by T Jeffery Parker, B Sc Lond., Professor of Biology in the University of Otago The work will consist of full directions for the dissection of the Lamprey, Skate, Cod, Lizard, Pigeon, and Rabbit, and will be illustrated by numerous woodcuts from the author's original drawings

THE death is announced of Count Alexander Erdody, a Member of the Pesth Academy of Sciences, vice-president of the Society for Plastic Art, and a liberal patron of science and art. His death occurred on January 24 at Vep (Hungary), he was eighty years of age We regret also to announce the death of Herr Gabriel Koch, a Frankfort tradesman and an eminent lepidopterist, whose "Schmetterlingsbuch" has a wide reputation in Germany. He died at Frankfort-on-Main on January 22, aged eighty. On February 2 died Prof Gorini at Lodi, well known by his works on volcanic phenomena He was a teacher at the Lodi High School, and one of the warmest advocates of cremation in Italy

EARTHQUAKES continue at Berne A new shock, directed from east to west, was felt in the north of the town on February 8, at 5 25 p m Shocks of earthquake are reported from Braila on February 11 at 7h 15m. a.m., and from Galatz at the same time

IT was not difficult to foresee that the warm weather which prevails now in the Alpine region, together with immense quantities of snow fallen during the previous days, would occasion several avalanches On February 13 a terrible one descended from the slopes of Mont Pourri, and covered with a mass of snow, thirty feet deep, the village of Brévières, in the Tignes commune. Thirty two persons were buried under the snow, and no less than three hundred peasants from the neighbourhood were engaged in sinking pits to reach the buried houses. Of the buried, twenty five were found alive, four were dead, and three are not yet discovered Two days later, another avalanche descended from the same mountain, and covered a space 10,000 metres wide, with a mass of snow fifteen to twenty metres deep. The pressure of air displaced by the avalanche was so great that all the windows of the village were broken within a few seconds The quantity of snow fallen during the previous days was so great that all communication was broken up between Brévières village and the bottom of the valley, a peasant from Tignes took thirteen hours to reach the next town, Bourg-Saint Maurice, travelling in the snow more than one metre deep.

THE provincial governments of Navarre and Logroño (Spain) have received the royal sanction to the necessary outlay for constructing and maintaining meteorological stations in these provinces.

OUR ASTRONOMICAL COLUMN

ENCKE'S COMET IN 1881 —So far as can be judged without the calculation of the perturbations since 1878 this comet will again arrive at perihelion about November 8 in the present year. In 1848, when the comet passed this point of its orbit on November 26, it was detected with the 15-inch refractor at Cambridge, U.S, on August 27, as "a misty patch of light, faint and without concentration its light coarsely granulated, so that were it not for its motion it might be mistaken for a group of stars of the 21st magnitude" (Bond) The theoretical intensity of light at this time was 0 21, and we find that, assuming the perihelion passage to occur on November 8, the comet should have this degree of brightness soon after the middle of August next, so that it may be anticipated observations will be practicable with the waning moon about the 20th of that month The last perihelion passage took place on July 26, 1878, the period of revolution at that time being 1200 58 days according to the late Dr von Asten. The aphelion distance is 4 0879, the perihelion distance 0 3335, and the minor semi-axis 1 1675 (the earth's mean distance from the sun = 1). The approach to the orbit of the planet Mercury is still very close (0 031) in about 126° 5 heliocentric longitude The nearest approximation of the two bodies that has occurred since the discovery of the comet's periodicity took place on November 22, 1848, when their distance was only 0 038 It is known that from his investigations on the motion of Encke's comet, von Asten inferred a much smaller value for the mass of Mercury than had been previously assigned, viz $\frac{1}{7636440}$

CINCINNATI MEASURES OF DOUBLE STARS.—Mr. Ormond Stone has issued an important series of measures of double stars made at the Observatory of Cincinnati, which is under his superintendence, between January 1, 1878, and September 1, 1879 The number of stars measured is 1054, of which 622 are south, and 432 north of the celestial equator 560 belong to Struve's catalogue, 171 were discovered by the Herschels, 162 by Mr Burnham, and 85 were found with the Cincinnati refractor, which has an aperture of eleven inches The measures of the southern stars have a special interest, as there are comparatively few previous ones upon record In his introduction Mr Stone points out the most notable differences between the Cincinnati measures of angle and distance, and those of Struve, Sir John Herschel, and others, we shall refer to several of these cases in a future column The volume is published by the Board of Directors of the University of Cincinnati, and will be a necessary addition to the libraries of those who are making the double stars their special study Mr Stone acknowledges his obligation to the Manual of Double Stars lately published by Messrs Crossley, Gledhill, and Wilson, and M Flammarion's "Catalogue des Étoiles Doubles et Multiples en Mouvement relatif certain."

THE MINOR PLANETS IN 1881 —The usual supplement to the *Berliner astronomisches Jahrbuch* (1883), containing its specialty, elements and ephemerides of the small planets for the present year, has been issued We have in it approximate ephemerides for every twentieth day throughout the year of 210 planets, the latest being No 217, and accurate opposition ephemerides of 58 Three planets are omitted for want of proper data for computation, viz No 99 *Dike*, No. 155 *Scylla*, and No 206 *Hersilia* A glance at this long series of ephemerides shows how wide a range over the heavens the apparent tracks of these small bodies present thus we find *Euphrosyne* in opposition in 52½° south declination, in the constellation Indus, and *Niobe* in the vicinity of ζ Persei, with 43° north declination A favourable opportunity for repeating observations for determination of the solar parallax would have been afforded if, in the first place, the actual position of No 132 *Œthra* were pretty accurately known, and if Mr Gill were able to utilise his heliometer at the Cape of Good Hope this planet on February 28 being distant from the earth less than 0 84 of the earth's mean distance from the sun, with 47° south declination and rather greater brightness than a star of the ninth magnitude.

CHEMICAL NOTES

HAUTEFEUILLE AND CHAPPUIS state (*Comptes rendus*) that when a high tension spark is passed through a mixture of nitrogen and oxygen, ozone and "pernitric acid" are produced, but the latter compound is readily decomposed with production of a less oxygenated body and oxygen When the electric discharge is passed through air in presence of water vapour very noticeable quantities of nitric acid are formed. The same observers have examined the absorption-spectrum of ozone and have recognised certain bands which they state are also found in the solar

spectrum They think that the blue colour of the sky may probably be partly due to the presence of ozone.

BRAME (in *Comptes rendus*) recommends the use of baryta in place of sodium carbonate and charcoal, in the ordinary dry test for arsenic If arsenious oxide is heated with baryta a mirror is obtained consisting partly of metallic arsenic, and partly of barium arsenate. the test does not succeed so well with arsenious sulphide

A CONSIDERABLE deposit of crystallised (octahedral) sulphur has been found under the soil of Paris, where organic refuse matter has long accumulated The sulphur appears to be a product of the deoxidising action of the carbon compounds present in the refuse on the calcium sulphate of the soil.

M. LOUGHININ continues, in the *Journal* of the Russian Chemical Society, his interesting researches on the quantities of heat produced by burning alcohols of the allyl series, he publishes in the *Journal* the figures corresponding to two new bodies of this series ($C_8H_{12}O$ and $C_{10}H_{20}O$), which figures, together with those he has already published in the *Comptes rendus* (vol. xci.), allow him to draw a complete table of the calories disengaged by the whole of the alcohols of this series

THE first number of the *Gazetta Chimica Italiana* for the present year is devoted, with the exception of a paper by M Fileti on gas analysis, to papers on organic chemistry these include work on Camphor Derivatives by Schiff, on Picrotoxin by Paterno and Oglialoro, and on Synthesis of Aromatic Aldehydes by the use of Chromyl Dichloride, by Paterno and Scichilone

IN the course of a paper on the Photo chemistry of Silver Chloride, Eder states (in *Wien. Akad Ber*) that this substance is more sensitive to light when substances which absorb chlorine are present, than when in the pure state To develop the latent image he recommends especially ammonium ferrocitrate, and hydroquinone along with ammonium carbonate.

BY the action of potassium dichromate and sulphuric acid on caffeine, Hinteregger has obtained as much as 40 per cent of dimethyl parabanic acid, and 39 per cent of the monomethyl acid from theobromine.

IN continuation of his investigations into the action of hydrochloric acid on metallic chlorides, Ditte describes (*Compt rend*) several new hydrated salts which crystallise from aqueous solutions when these are saturated with hydrochloric acid In the absence of hydrochloric acid hydrated salts with more water of crystallisation are always produced The following table contains the principal results obtained by Ditte —

Aqueous solution		Solution saturated with HCl at 12°	
Grams of salt dissolved per litre	Crystals which form	Grams of salt dissolved per litre	Crystals which form
700	$CaCl_2.6H_2O$	270	$CaCl_2\ 2H_2O$
500	$SrCl_2\ 6H_2O$	20	$SrCl_2\ 2H_2O$
720	$MgCl_2\ 6H_2O$	65	$MgCl_2\ 2H_2O$
415	$CoCl_2\ 6H_2O$	205	$2CoCl_2\ 3H_2O$ and $CoCl_2\ H_2O$
600	$NiCl_2\ 6H_2O$	40	$NiCl_2\ H_2O$
870	$MnCl_2\ 4H_2O$	190	$MnCl_2\ H_2O$
630	$CuCl_2\ 2H_2O$	290	$CuCl_2.H_2O$

M. POUCHET describes in *Compt. rend* a method for destroying organic matter before testing for mineral poisons in contents of a stomach, &c, the method is based on the oxidising action of potassium-hydrogen sulphate followed by addition of sulphuric acid.

PHYSICAL NOTES

IN a little mathematical note in the *Comptes rendus* M. Thollon investigates the general equation for the passage of light through a prism, and thence deduces the proposition that for every prism there is an angle of minimum resolving power Differentiating the general equation with respect to the index of refraction, he obtains, first, a differential equation expressing the dependence of the angular distance between two rays upon the dispersive index A separate differentiation with respect to the angle of incidence yields a second differential equation expressing the dependence of the apparent width of the slit as seen through the prism upon the angular aperture of the slit, as viewed from the prism through the collimator. Hence a relation can be obtained between the angular distance between two rays and their apparent breadth Further examination of the equations shows that for a certain incidence there will be a minimum of resolution (*i.e.* an incidence at which the rays are least well defined), and that for another incidence there will be a minimum of dispersion, these two incidences being symmetrically related to the angle of incidence corresponding to minimum deviation M Thollon states that these deductions may be readily verified by the following experiment —A dense flint glass prism is adjusted in the position of minimum deviation for the rays D upon its supporting table in the spectroscope, lit by a sodium flame The slit is then narrowed or widened until the two yellow rays are just in mutual contact On then turning the prism around its axis so as to increase the angle of incidence the two rays are seen to separate and to become perfectly distinct, *the angular distance between them diminishing all the while* But if the prism be turned in the opposite direction, so as to decrease the angle of incidence, the yellow band is seen to become wider, but without being resolved into two rays Perhaps this research may explain why the so called "half prism" spectroscope failed to realise all the hopes of its inventor

RECENT observations by Herr Wullner and Grotrian (*Wied Ann* No 12) seem to prove that the specific volume of vapours is independent of the size of the space in which it is determined. They also confirm Herr Herwig's result, that vapours always undergo precipitation before reaching the so-called maximum tension Further, the tension at which condensation begins is found to have a relation to the maximum tension, which depends on the nature of the liquid, but is nearly independent of the temperature Experiments made in order to find in what measure vapour must be compressed so as to present maximum tension, gave the unexpected result, that there is in general no maximum tension in the sense hitherto accepted, but that the tension of saturated vapours, even when they are in contact with a large and excessive quantity of liquid, is perceptibly increased by compression

THE varieties of the electric discharge in gases are fully investigated by Herr Lehmann in a recent paper (*Wied. Ann* No 12) The chief conclusion is that there are four well-characterised modes of discharge to be distinguished, viz. glow, brush, band, and spark discharge; and these may all be obtained in air of ordinary (as well as of less) density, and also in other gases, with inserted resistances and breaks, and with sharp and rounded form of electrodes, at great or small distances The principal characteristics are these —1. Glow-discharge, positive glow, negative light pencil, consisting of two parts separated by a dark space. 2 Brush-discharge, positive brush, consisting of stem and branches, negative light-pencil 3 Band-discharge, positive light with two places of intermittence, sometimes stratified, and separated from the negative glow by a dark space 4 Spark-discharge band of light connecting both electrodes; with two places of intermittence, brushes of metallic vapour at both ends, the positive longer, the negative thicker, sometimes oblique dark spaces.

THE influence of traction and vibrations of a metallic wire on its electric conductivity is the subject of a paper by Dr. De Marchi in the *Reale Ist Lomb Rend* (vol xiii fasc xix). The results he arrives at are summed up thus 1 Any traction of a metallic wire increases in general its resistance, when the traction is very slight however there is diminution instead of increase, with increase of traction the case comes under the general law 2 In general the increments are proportional to the increments of traction, up to a certain limit, beyond which the variations of resistance are manifested in sudden bounds, indicating an instantaneous and profound perturbation of the molecular state of the wire. 3. The law of increments of resistance is apparently independent of that of the elongations 4. Any vibration of a wire is accompanied by a variation of resistance generally very perceptible. In most cases there is decrease of resistance if the vibration be sonorous, and more so if harmonic, increase, if the vibration be silent. This last law however requires confirmation.

IT is known that M. Plateau distinguishes between an internal and a surface viscosity of liquids, a distinction which Signor Marangoni does not consider warranted Herr Oberbeck (*Wied Ann* No. 12) has approached the question experimentally thus: A brass cross is hung bifilarly with two platinum wires by one arm; its horizontal arms carry weights whose positions can be varied by screwing, so as to vary the swing, it carries a mirror reflecting a scale, and to the lower arm is attached a thin plate

or cylinder of brass to swing in the liquid at various depths. The whole can be raised or lowered with a micrometer screw, and it is thrown into slight oscillation by means of a magnet A rectangular glass vessel is used for the liquid. The author finds that with distilled water the resistance increases suddenly and to a quite considerable extent whenever the upper edge of the plate comes into the free surface, and he does not doubt this is due to increased friction in the surface layer. The increase of resistance from the last previous position of the plate was 60·9 per cent, and with four aqueous salt solutions there was also an increase, varying between 75 1 to 54·1 per cent. Precautions adopted to prevent the presence of foreign particles on the surface (filtration, covering with moist filter-paper, &c) had hardly any influence on the values. Long-standing of the liquid increased the surface-resistance, and stirring then diminished it, still it was always considerable at first With M. Plateau, Herr Oberbeck found a decrease of resistance at the surface in some liquids; this was comparatively small (alcohol 11·9 per cent, oil of turpentine 12·6, sulphide of carbon 26 3, &c.). A small addition of alcohol to water lessens its surface-resistance property in a marked degree, and with further addition the mixture behaves like pure alcohol.

In a paper on dew and fog (*Zeits. fur Meteor.* Bd xv. p. 381) Herr Dines, from observations of the former with watch-glasses exposed on different substances at night, estimates the annual dew formation to be about 35·5 mm. (on grass, 26 mm); at the best 38 mm The average nightly dew (in 198 observations) was hardly 0 1 mm; in a few cases 0 3 mm., average on grass 0·07 mm. Morning fog along a river course arises when the water is warmer than the air over it. The evaporation goes on more quickly than the vapour can be carried away, hence the latter is condensed and spreads as fog (similarly with fogs over the Gulf Stream). The evening fog on moist low-lying meadows is due to the fact that the grass surface cooled by radiation cools the lowest air-layers, so causing condensation of the aqueous vapour The fine drops of dew, Herr Dines estimates, are about 0·001 mm. in diameter, while the finest rain-drops have a diameter of 0 3 to 0 33 mm. The particles of fog vary in diameter from 0 016 to 0·127 mm.

The colour-changes presented in the microscope by various substances (chiefly mineral) of uneven surface, when immersed successively in liquids of different refracting power, have been made by Herr Maschke (*Wied Ann.* No. 12) the basis of a method of distinguishing substances Such changes may be had, *e.g.* with small glass particles, observed in water, in oil of almonds, and in mixtures of the latter with oil of cassia. The dark and the bright parts of the image show different series of colours. That the effects are simply due to prismatic action of the object appears from the fact that they may be got without the microscope, by looking *e.g.* through a tube at a piece of rock-crystal in water, &c. For mineral objects Herr Maschke used five liquids; amylic alcohol and glycerine, besides the three just named. By various mixtures of these a series of liquids is obtained, giving any desired index of refraction from 1 333 to 1·606. (Coloration begins when the refraction of the liquid is near that of the object; when the former greatly exceeds the latter a certain stability of colour appears) The method is not applicable to bodies opaque in the microscope, or having too strong colours of their own, nor yet to bodies having a greater index of refraction than oil of cassia It may, too, prove difficult sometimes to find a liquid sufficiently indifferent to the object. Herr Maschke indicates how the refractive indices of substances may be compared by his method, and (a more difficult task) numerically determined. He also gives a number of his own determinations.

An interesting study, by Herr Holtz, of the electric discharge in insulating liquids appears in *Wiedemann's Annalen*, No. 12. Among other results the length of spark is found hardly at all dependent on quantity or on retardation of the discharge. Naturally it differs in different liquids, but only in one liquid (sulphuric ether) did it increase with velocity of rotation of the disk (this appears to be due rather to the mode of preparation than to the nature of the liquid). As in air, with dissimilar electrodes, the spark-length is conditioned by the polarity of the electrodes The thickness, sound, and luminous force of the spark depend chiefly on the electric quantity and the retardation. The spark is thinner than in air, but brighter (brightest in sulphide of carbon, least bright in olive-oil and ether). It is more crooked than in air. Throughout its length it shows innumerable very small dark spaces. With large striking distance it appears within a largely-branching brush. (The appearances of the brush discharge, got best in petroleum, are also described)

From data obtained in various parts of Germany, Austria, and Switzerland (*Wied. Ann.* No. 12), Herr Holtz finds a well-marked increase in risk from lightning in these parts since 1854, while no such increase appears in the number of thunderstorms. Hence he infers the causes to be telluric, and he suggests as probable causes the clearing of forests and increase of railways (attracting storms more to towns and villages), further, the increased use of metal in buildings

Prof. Bombini has lately communicated to the Bologna Academy an interesting paper on spherohedry in crystallisation (*Riv Sci. Ind* No 21), by which he means any known manner of production of a fibrous-radiate structure From a survey of facts he concludes that the great phenomenon of crystallisation comprises two different orders of attractive energy In the first there is simple centralised attraction, with concurrence of the elements attracted to a common centre In the second there is attraction with directive polarity according to certain axes of symmetry, and concurrence of the attracted elements towards nodal points in a certain reticular system. Between these two kinds of crystallogenic action there are many gradations, or rather syntheses, superpositions Further, the correlations between the sphericity characteristic of the liquid state, the spherohedry of globosity with radiated structure, the isometry of radiate pseudocubical groups; leading from the *amorphous* state of liquids to the absolutely reticular state of the true crystals (isotropic, orthoprismatic, and clinohedric) confirm the cubicity of the first system, and at the same time point to some further significant terms in the progressive series of the physical states of inorganic matter Prof. Bombini indicates three conditions I. Spherohedric crystallisation; II. Polyhedric crystallisation, and III Pseudocubic, &c., crystallisation The third may be considered intermediate between the first and the second; the first appearing as a term of transition between the sphericity of the liquid state and the polyhedry of physical solidity.

GEOGRAPHICAL NOTES

The February *Proceedings* of the Geographical Society opens with Capt Holdich's paper on the "Geographical Results of the Afghan Expedition"; but of more importance from a geographical point of view are Mr. Wilfred Powell's "Observations on New Britain and Neighbouring Islands" The latter is accompanied by a sketch-survey of the north-east portion of New Britain by the author, which of itself is of considerable value. A correspondence between Admiral Ryder, Naval Commander in-Chief at Portsmouth, and the Council of the Society follows, by which we learn that the latter, in declining his offer to establish certain medals, are of opinion that "the plan of granting medals to officers and seamen for independent surveys is impracticable," and further that they do not consider it their business to take any action in regard to an international congress of hydrographers.

Under the title of "Union Géographique du Nord de la France," a geographical association was formed some time ago, with its head-quarters at Douai, and branches at Amiens, Arras, Boulogne, Cambrai, Charleville, Dunkerque, Laon, Lille, St. Omer, St. Quentin, and Valenciennes. In the first part of the *Bulletin* of the Union, which has been sent to us, the list of members covers about fifty pages. The object of the association is by every means to promote the development and spread of geographical knowledge, investigating specially questions relating to the industry, commerce, and agriculture of the region of the Nord. The *Bulletin*, a volume of some size, contains papers on the Exploration of the Sahara, Nordenskjold's last voyage, a Project for Exploring the Wellé, the Proposed Canal between the Atlantic and the Mediterranean, and the Maritime and Commercial Statistics of Dunkerque In the *Comptes rendus* of the meetings of the various societies are abstracts of papers on a great variety of subjects, and there are besides a geographical chronicle and a pretty full bibliography. We have no doubt the Association will do much good in the North of France

Prof Ujfalvy has left St Petersburg on his return from Central Asia. The journey he made during last summer was not so successful as his preceding travels, because of a serious

illness which kept the traveller in his bed for more than two months. Nevertheless the ethnographical collections brought in are very interesting.

THE *Smolensky Vestnik* gives the following information as to Colonel Prjevalsky. He was born on April 12, 1839, at the village of Otradnoye, in the Smolensk district His mother and his old nurse, both still alive, were the first who inspired him with a warm love of nature, and his life, on the estate of his mother, contributed to the development of this love. He studied at the Smolensk College (gymnasium), and notwithstanding the desire of his mother, who wished him to enter a university, he entered as a sub-officer in the Polotzk infantry regiment Promoted to the grade of officer, he went to the military academy, and soon we find him as an officer during the Polish campaign, and afterwards as a teacher of geography and history in the cadet school at Warsaw. A keen hunter, he could not stay long in a city, and he soon undertook a journey to the Oussouri. This determined his ultimate career; the richness of the fauna and the pleasure of hunting in uncivilised countries determined him to undertake further journeys, first to Southern Mongolia, then to Lob-nor, and finally to Tibet, which he reached last year

UNDER the title of "The Expiring Continent," Mr. A W Mitchinson gives an account of his travels in Senegambia, mainly of journeys he made up the rivers Senegal and Gambia. The work contains no dates, thus detracting somewhat from its scientific value, and abounds with speculations and reflections on all sorts of subjects connected with Africa. His notes on what he saw during his journeys are of value as showing the recent condition of the country visited, and, as may be inferred from the title, the author's views are rather desponding His inference from his observations on the small district visited by him, that the African continent as a whole is "expiring," is far too sweeping. While like the other continents it contains "desert places," the bulk of it, so far as we know it, is capable of the greatest industrial development That its waters are drying up as a whole there is no reason for believing, but evidently in this and in other respects there is ample room for trustworthy scientific examination The publishers are Allen and Co.

THE February number of *Petermann's Mittheilungen* begins with a paper on the Chukchis on the shores of the Arctic Ocean, their number and present position, based on two articles by O Nordqvist and Lieut Hovgaard. Dr Gustav Radde contributes the first part of a narrative of his journey to Talgsch, Aderbeijan, and Sawalan in 1879-80 From the papers in the *North American Review* a long account is given of M Désiré Charnay's explorations of the ruins in Central America There is an elaborate and detailed map, with accompanying text, illustrating Dr Junker's journey through the valley of the Chor Baraka, in the Egyptian province Taka in 1876.

MESSRS. W. AND A. K JOHNSTON have sent us the first two parts of a "Statistical Atlas of England, Scotland, and Ireland," by Mr. G. Phillips Bevan. These two parts include Religious and Educational Statistic, and subsequent parts will be devoted to Industry, Crime, Marine, Agricultural, Railways, Geology, and Mining, &c.; there will be fifteen parts in all. In the first two parts a vast amount of useful statistics are graphically exhibited on the maps, and systematically arranged in separate tables. Much of the information thus exhibited could not be obtained from any other single source

No 90, the concluding part of the fifteenth volume of the *Zeitschrift* of the Berlin Geographical Society, contains the conclusion of the late Dr. Erwin von Bay's interesting journal of his journey from Tripoli to Ghât and Air, and a paper on the region which caused the recent contest between Chili and Bolivia, by Dr C Marten The rest of the number, 130 pages, is occupied with the bibliography of the past year, one of the most valuable features of this most important of geographical journals The bibliography is practically exhaustive, is arranged in a thoroughly systematic manner, and includes works relating to all departments of geography.

M. SIBIRIAKOFF has safely returned to St Petersburg, where he had a brilliant reception. At a meeting of the Society for the Furtherance of Russian Commercial Navigation, M. Sibiriakoff pointed out the grave errors contained in Russian marine charts, which caused two of his captains to mistake the Gydan Bay for the Yenisei Estuary. They entered it on September 12, and soon met with thick-packed ice. The *Nordland* had stopped at once, the *Oskar Dickson* proceeding some 100 versts further to the south Thence the travellers had journeyed to Obdorsk, with Samogedes as guides.

THE Ruppell fund at Frankfort-on-the-Main, which was founded in honour of the Nestor of African travellers, Dr. Eduard Ruppell, and for the exclusive object of supporting scientific exploration, consisted of the sum of 35,570 marks (1770*l*.) at the end of last year From this the Senkenberg Naturforschende Gesellschaft, at their last meeting, granted the sum of 3000 marks (150*l*.) to Dr. Wilhelm Kobelt of Schwanheim, an eminent conchologist Dr Kobelt is now engaged upon the investigation of the existing and fossil molluskan fauna of the Mediterranean, and had during the last few years repeatedly visited Italy and Sicily for this purpose His next tour, which is to extend from March to September, will comprise Spain, Algeria, and, if possible, Morocco. We may remind our readers that the journeys of Drs. Noll and Grenacher to Spain and the Canary Islands in 1871, as well as those of Verkruzen to Newfoundland in 1874 and 1875, were also largely supported by grants from the Ruppell fund

GEODETICAL measurements will be begun next spring on the stretch between Great St Bernard and the St. Gothard for connecting together the Italian and the Swiss geodetical network

A NEW expedition will start, next spring, for the exploration of the Obi, under the direction of M Moiséeff Six pupils of the Marine School of Arkhangelsk will accompany him

THERE is some talk of uniting the three geographical societies of Switzerland, those of Berne, Geneva, and St. Gall, as well as those which may be created afterwards, into one great Swiss geographical association, which will have a central committee and an annual general assembly devoted to the study of geographical questions, and especially of those which have a commercial interest

UNDER the title of "Das Frauenleben der Erde," illustrated by A. von Schweiger-Lerchenfeld, A Hartleben of Vienna has published a highly interesting description of the social life of the women of all nations The work contains much that is of ethnographical value, and the numerous well-executed illustrations, as well as the attractive style of the text, are likely to render it of popular interest.

THE Austrian Section of the German and Austrian Alpine Society held its annual meeting at Vienna, on January 26 last. The Section now numbers 1302 members.

ON January 29 a branch of the Berlin "Centralverein" for commercial geography was formed at Dusseldorf. The new branch is directing its main attention to South Africa

IN the place of the late Dr Mook, Dr Manthey has joined the Riebeck expedition, which will leave Cairo in the course of a few days, and will, first of all, proceed to Socotra by way of Aden

ABNORMAL VARIATIONS OF BAROMETRIC PRESSURE IN THE TROPICS AND THEIR RELATIONS TO SUN-SPOTS, RAINFALL, AND FAMINES

MR F CHAMBERS, in his valuable and highly interesting article (vol xxiii p. 88) under the above title, has made an important step towards placing the relation between secular weather changes and sun-spots on a more substantial basis than it has hitherto occupied This has been mainly effected by his employing the most reliable data we at present possess of the latter phenomena, thereby bringing the salient features of their *minor* variations for the first time into direct comparison with a definite meteorological element, which, it may be remarked, possesses the distinct advantage of representing the integrated effect of changes occurring throughout the entire atmospheric envelope

He has also shown how the remarkable lag which takes place in the occurrence of the critical barometric epochs at the more easterly stations may be utilised to previse famines from a knowledge of what is going on at more westerly ones.

This however would only be practicable if we knew for certain that famines in all the districts mentioned, invariably took their rise from one set of conditions, such as failure of the usual summer rains, preceded and accompanied by high barometric pressure. In attributing the majority of the famines occurring within the tropics to such a proximate cause, Mr Chambers

would no doubt be correct, but this relation between pressure and rainfall, strange though the fact may appear, does not apparently hold in the winter in the sub tropical region of Northern India, nor is famine always caused in *this* region by a failure of summer rain alone

For as Mr. S. A. Hill has shown in a paper on "Variations of Rainfall in Northern India" ("Indian Meteorological Memoirs," No vii, p 204), a *heavy* winter rainfall generally coincides with a *high* barometric pressure over Northern India, and *vice versâ*, while two of the most severe famines in Mr Chambers' list, viz, those of 1837-38 and 1860-61, in Northern India were caused by "a partial failure of the summer rains, followed by an almost complete absence of the usual winter fall."

It is straining the evidence therefore to attempt to relate these famines, as Mr. Chambers has done, to the *previous* occurrence of high barometric pressures, since if the law just quoted held good, the famine of 1860-61 was mainly due to the absence of winter rain, caused by the *low* pressure which observations show actually existed at that time, and the same was very probably the case in 1837 38, a strongly-marked epoch of sun-spot maximum

It has moreover been shown by Mr Hill in the paper just referred to that "the summer rains of the North-West Provinces and Rajpootana have failed quite as often when sun-spots were numerous as when they were few, but whereas in the *former* case a comparatively slight scarcity has generally been developed into a severe famine through the failure of the winter rains, this has seldom happened in the latter case, the distress at such times being alleviated by the in-gathering of the rabi harvest, rendered more abundant than usual by a copious winter fall" This saving clause with respect to the winter rainfall of Northern India does not unfortunately apply to Southern India, where failure of the usual monsoon supply means drought and probably famine until the next monsoon, *i e* for an entire year

On the whole it is plain that high and low atmospheric pressures differ specifically in their effects in different parts of the Indian peninsula, since while the former is generally associated with drought in the southern provinces, the latter in the winter is almost equally fatal in the northern provinces If therefore the future prevision of famines is to be based on the empirical law connecting high barometric pressure with the occurrence of drought and famine, propounded by Mr Chambers, it must be remembered that this law strictly applies only to regions where the annual water supply is dependent upon the monsoons alone, and therefore lying for the most part between the two tropics

It may be remarked that at least half of the Indian peninsula lies north of the tropic of Cancer

Though I am sceptical as to the idea of motion from west to east, conveyed by the existence of a lag at the more easterly stations, this in no way affects the possibility of prevision as long as the lag remains fairly constant I am therefore of opinion that in regard to this question the evidence furnished by Mr Chambers is exceedingly valuable, and that so long as districts are only taken into account that lie within the tropics, such as Southern India, the possibility of prevising famines by noting the occurrence of barometric maxima at more westerly stations may in time be accomplished For Northern India, and probably other similar sub-tropical regions, the matter is at present more complicated E DOUGLAS ARCHIBALD

P S.—In the preceding letter I have only dwelt upon the limitation to be applied to Mr. Chambers's conclusions in the case of Northern India. It is obvious however that there are at least two distinct difficulties to be explained, before they can be finally accepted, even for countries within the Tropics, viz. (1) Why the barometric waves should commence on one meridian rather than on another, and (2) if, as Mr Chambers thinks, the waves of pressure travel slowly round the earth, why they do not reappear at the place where they started after an interval of about one year and eight months (calculated from the lags given in Mr. Chambers's paper). At present there does not appear to be the slightest evidence to show that they reappear at all, and if they do not, when and where do they disappear?—E. D. A.

MR. E. D. ARCHIBALD states in his friendly criticism of my paper on "Abnormal Variations of Barometric Pressure in the Tropics, and their Relations to Sunspots, Rainfall, and Famines," that the occurrence of a decided lag in the barometric movements at easterly, as compared with westerly stations, could only be utilised to previse famines if we knew for certain that famines in those districts to which the method is applied invariably took their rise from *one* set of conditions, such as failure of the usual summer rains, preceded and accompanied by high barometric pressure. It appears to me, however, that if the variations of the rainfall can be *definitely* related in *any* manner to the corresponding variations of the barometric pressure, there is no necessity for such a limitation If, for instance, in Northern India, "a heavy winter rainfall generally coincides with a high barometric pressure, and *vice versâ*," as Mr. Archibald seems prepared to admit, then the occurrence in the *winter* of a *high* pressure would portend a *heavy* winter rainfall, and *vice versâ*, and in this case the failure of the winter rains might be foreseen by observing the progress eastward of the barometric *minima*.

But I am not aware that the relation above mentioned between the barometric pressure and the winter rainfall of Northern India has yet been worked out with sufficient definiteness for the purpose in view, for although there does appear to be some evidence in favour of that relation when the *average* pressure and the *total* rainfall of the whole winter are taken into account, yet on the other hand it is now known that the short rainy periods of the winter are periods of relatively *low* pressure It is not improbable that these periods of low pressure, and the rainfall which accompanies them, are connected with the feeble cyclonic disturbances which (as appears from the charts of storm-tracks published by the American Government) occasionally enter the north-west of India in the winter months and travel down the Ganges Valley sometimes as far as Bengal The facts concerning these winter rains seem to accord far better with this view of their origin than with the old notion of their connection with the upper anti-monsoon current, an idea which I observe has now been abandoned by Mr Blanford, the Meteorological Reporter to the Government of India, although up to a recent date it was still retained by some other Indian meteorologists. The question is as yet involved in much obscurity, and I must, with the above suggestion, leave it to be dealt with by those more immediately concerned

But whatever the relation between the winter rainfall and the barometric pressure may be, I cannot help thinking that Mr. Archibald attaches an exaggerated relative importance to these winter rains, for, from the register of Allahabad, the capital of the province, it appears that the winter rain amounts on the average to only 1 54", whereas the average summer rain amounts to 36 84". And similarly at Delhi, the average total winter rain is only 3 01", while that of the summer is no less than 24 60" Such being the case, I think it would be difficult to prove that "the famine of 1860–61 in the North-West Provinces was *mainly* due to the absence of the winter rain," more especially as the summer rain of 1860 in that province was deficient to the extent of nearly one-half, the fall having amounted to only 54 per cent of the average

Neither does it seem clear why the methods of forecasting the general character of a coming season, which are suggested in my paper, should of necessity be applicable only to intertropical regions. It is true that I have dealt only with barometric data furnished by stations lying within the tropics, but my only reason for doing so was that there seemed a better prospect of obtaining definite results from the records of tropical stations, where the weather is generally of a comparatively settled character, than from those of stations situated in extra-tropical regions, where the weather is generally more disturbed Indeed I am not without hope that the results I have obtained will induce European meteorologists to take up the subject with a view to the possibility of prevising the general character of coming seasons in Europe from observations recorded in America

FRED. CHAMBERS

STANDARD THERMOMETERS

DEAR SIR,—The Kew Committee have instructed me to forward you the enclosed Memorandum on Standard Thermometers, and to request on their behalf that you would be so good as to publish it in NATURE if you consider it suitable for insertion. G. M WHIPPLE

Kew Observatory, Richmond, Surrey, February 9

DR. LEONARD WALDO has recently communicated to the *American Journal of Science* an article entitled "Papers on Thermometry from the Winchester Observatory of Yale College."

In it he treats of the errors of three standard thermometers constructed for him at the Kew Observatory, and after describing minutely the instruments, the manner in which he verified the accuracy of the positions of the fixed points, and the appliances he used in the work, proceeds to state that he then rigorously examined the thermometers for errors depending on calibration. Of these he says: "The results of our calibration are given in the following table. The observations were made with Apparatus II., and special care was taken to guard against any changes of temperature. The reduced results are as follows, where each line is the mean of three observations:—

Thermometer	Date	Extreme readings	Computed length of col.	Correction for calibration error
	1880	° °	°	° °
Kew, 578	Oct. 15	− 1·1 + 33·6	32·487	At 32 C. = +0·007
		+ 31·0 + 65·1	32·507	65 C. = −0·014
		+ 63·7 + 98·6	32·487	99 C. = +0·007
Kew, 584	Oct. 15	+ 32·2 + 82·3	49·040	79 F. = +0·021
		+ 76·1 + 127·3	49·068	123 F. = −0·006
		+ 119·1 + 170·1	49·078	166 F. = −0·016
		+ 162·2 + 213·2	49·060	212 F. = +0·001
Kew, 585	Oct. 15	− 1·0 + 50·9	49·813	50 C. = +0·015
		+ 49·0 + 100·9	49·843	100 C. = 0·000
		+ 99·1 + 151·7	49·820	150 C. = +0·008
		+ 148·9 + 201·0	49·807	200 C. = +0·029
		+ 199·2 + 250·8	49·747	250 C. = +0·110

REMARKS.—The observations were all made by daylight, and at one sitting for each thermometer. The extreme variations of the temperature of the room during the observations as measured by two thermometers, one at each end of the tube being measured, were as follows:—

Kew, 578 = 0°·0 F.
584 = 0·1 F.
585 = 0·1 F.

The length of the column used for the Kew calibration, and by which the thermometers were graduated, was 5°·026 C. for Kew 578, 10°·405 F. for 584, and 10°·673 F. for Kew 585. We may therefore conclude that between 0° and 100° C. the errors of the three Kew standards depending on the calibration are practically insensible, for the errors shown above are too small to be certainly detected, owing to the width of the lines which make up the graduation of the thermometer scales.

Accidental errors of graduation could not be guarded against except by the direct examination of every degree, and that accordingly has been done.

The tedious examination of each degree was accomplished with the aid of Prof. J. E. Kershner. We used the apparatus I., and each degree was measured twice. The resulting means were expressed in terms of hundredths of one division of the eye-piece micrometer, and gave a subdivision of about $\frac{1}{1350}$, $\frac{1}{2250}$, and $\frac{1}{2200}$ of 1° in the cases of Kew 578, 584, and 585 respectively. There were about 2300 separate micrometer readings made, and the result of the reductions shows that no sensible accidental errors have been introduced into the graduations of these standards."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The latest edition of the schedule of subjects for the Moral Sciences Tripos fully recognises physiology. In the advanced part of the examination special knowledge is required (1) of the physiology of the senses and of the central nervous system; (2) of experimental investigations into the intensity and duration of psychical states; and (3) of such facts of mental pathology as are of psychological interest. Questions will also be set relating to the philosophic treatment of the relation of body and mind as regards both the method and the general theory of psychology. Mr. Lewes's "Problems of Life and Mind," vols. iii. v., Dr. Michael Foster's "Text-book of Physiology," Book iii., Wundt's "Physiologische Psychologie," Fechner's "In Sachen der Psychophysik," Maudsley's "Physiology of Mind" and "Pathology of Mind" are among the books recommended.

MR. J. M. H. MUNRO, D.Sc. Lond., F.C.S., has been elected resident Professor of Chemistry in the Wilts and Hants Agricultural College, Downton, Salisbury, and he will act in co-operation with Prof. A. H. Church, M.A. Oxon. Dr. Munro headed the list in first-class honours in chemistry at both of the examinations for the B.Sc. degree, and obtained the chemical exhibition of the University in 1874. He was also classed in botany and vegetable physiology, and in logic and moral philosophy, and took the Doctor's degree in 1877. He recently received a grant from the Chemical Society in aid of a research on which he is at present engaged.

SCIENTIFIC SERIALS

THE *Proceedings of the Royal Irish Academy* ("Science"), part 5, vol. iii., series ii., December, 1880, contains—W. R. Roberts, on the satellite of a line meeting a cubic.—A. H. Anglin, mathematical notes.—Prof. J. P. O'Reilly, on the directions of main lines of jointing observable in the rocks about the Bay of Dublin, and their relations with adjacent coast-lines;—also on the correlation of the lines of faulting of the Palamow coal field district, Northern India, with the neighbouring coast lines.—Prof. E. Davy, preliminary report on some new organic nitroprussides.—Prof. W. King, preliminary notice of a memoir on rock-jointing in its relation to phenomena in physical geography and physical geology.—J. F. Knott, on some anomalies in human anatomy (woodcuts).—Prof. Mackintosh, note on the occurrence of a premaxillo-frontal suture in the skull of the koala (*Phascolarctos cinereus*) (with plates 10 to 13).—G. H. and G. A. Kinahan, eurites or basic felstones of Silurian age.—G. H. Kinahan, supposed Upper Cambrian rocks in the counties of Tyrone and Mayo.

THE *Proceedings of the Royal Irish Academy*.—"Polite Literature and Antiquities," part 2, vol. ii. series ii., December, 1880, contains the following papers of interest to the student of nature:—W. Frazer, description of a great sepulchral mound near Donnybrook (in Co. Dublin), containing human and animal remains, as well as some objects of antiquarian interest referable to the tenth or twelfth centuries (woodcuts).—G. Allmann Armstrong, particulars relative to the finding of human remains in the neighbourhood of Dundalk (woodcut).—R. J. Ussher and G. H. Kinahan, on a submarine crannog at Ardmore, Co. Waterford (plate 1 and woodcut).—Thos. Plunkett, on an ancient settlement found about twenty-one feet beneath the surface of the peat in the coal-bog at Boho, Co. Fermanagh (plate 2).

THE *Scientific Proceedings of the Royal Dublin Society*, vol. ii. new series, part vii., November, 1880, contains:—V. Ball, on the mode of occurrence and distribution of diamonds in India.—A. B. Wynne, on some points in the physical geology of the Dingle and Iveragh Promontories.—Dr. C. A. Cameron, on the action of water upon mercuric sulphate.—J. H. Tuby, voluntary act of self-destruction by the worker bee.—G. F. Fitzgerald, F.T.C.D., notes on fluorescence.—Thos. Plunkett, on chert in the limestone of Knockbeg, county of Fermanagh (woodcut).—R. M. Barrington, M.A., on the introduction of the squirrel into Ireland (with a map).

Vol. iii., new series, part 1, January 1881, contains:—C. E. Burton and Howard Grubb, on a new form of ghost micrometer for use with astronomical telescopes (plates 1 to 4).—E. T. Hardman, on a travertine from Ballisodare near Sligo, containing a considerable amount of strontium.—W. Smith, preliminary note on the manufacture of paper from melic grass (*Molinia cærulea*).—D. M'Ardle.—On some new or rare Irish Hepaticæ (with plates 5 and 6).—Percy Evans Freke, on North American birds crossing the Atlantic (with tables).

Journal and Proceedings of the Royal Society of New South Wales, vol. xiii., 1879 (Agents in London Messrs. Trubner and Co.), contains—On the "gem" cluster in Argo, by H. C. Russell.—On the water of Sydney Harbour, by the Rev. W. H. Sharp.—On the anatomy of Distichopora, with a monograph of the genus, by Rev. J. E. Tenison-Woods (two plates).—On the geological formations of New Zealand compared with those of Australia, by Dr. Jas. Hector.—On the languages of Australia in connection with those of the Mozambique and of the south of Africa, by Hyde Clarke.—On *Ottelia prœterita*, F. v. M., by Baron von Muller, with a plate (an alisma like leaf-impression from the green-bush quarry near to Parramatta, apparently allied

to *Ottelia ovalifolia*)—On a compiled catalogue of latitude stars, epoch 1880, by H. S. Hawkins.—On the occurrence of remarkable boulders in the Hawkesbury rocks, by C. S. Wilkinson.—On the Wentworth hurricane, by H. C. Russell.—Abstract of the meteorological observations taken at the Sydney Observatory, by H. C. Russell. (January to December, 1879).

American Journal of Science, December, 1880.—Note on the zodiacal light, by H. C. Lewis.—The early stages of renilla, by E. B. Wilson.—Geological relations of the limestone belts of Westchester, co. New York, by S. D. Dana.—Abstract of some palæontological studies of the life-history of *Spirifer brevis*, H, by H. S. Williams.—Index to vols. xi.-xx.

Journal of the Franklin Institute, January.—Experiments with the Parkins machinery of the steam yacht *Anthracite*, by Chief-Engineer Isherwood.—The determination of silicon and titanium in pig-iron and steel, by Dr. Drown and Mr. Shimer.—An adaptation of Bessemer plant to the basic process, by Mr. Holley.—The value of the study of the mechanical theory of heat, by Mr. Wolff.—Blasting, by Mr. Kirk.—On the wholesomeness of drinking-water, by Mr. Haines.—An inquiry into the laws of the beautiful in music, by Prof. Clarke.

THE last number of the *Journal* of the Physical and Chemical Society (Russian) contains, besides minutes of meetings, papers on the electrolyse of formic and mellite acids, by M. N. Bunge.—On the variations of the quantity and pressure of oxygen in the lungs, by Prof. Ivan Setchenoff.—On products of the decomposition of albuminous matters, by Dr. Danilevsky.—On hops, by M. Tchekh; and several smaller notes on organic chemistry.—In the physical part, M. Shvedoff continues his researches on hail, trying to establish by various very interesting arguments the cosmic origin of hail, which he considers as a variety of meteorites.—M. Reinboth describes a new naphtha barometer which has a great sensibility.—M. Van der Flith gives several new mathematical formulæ concerning electrodynamics.

THE *Schriften der physikalisch-okonomischen Gesellschaft zu Konigsberg* (1879, i. and ii., 1880, i.)—These parts contain the following papers:—On the *Uredo* fungus, by Dr. Caspary.—On the Gastraa theory, by Prof. Kupffer.—On pisciculture, by Dr. Seidlitz.—On some acoustical and optical experiments with the telephone, by Prof. Berthold.—On the phonograph, by Dr. Zenker.—On the ancestors of carnivora, by Dr. Albrecht.—What is species, and what variety? by Dr. Caspary.—On bacteria, by Dr. Baumgarten.—On the observations made at the station for measuring the temperature of the soil in various depths at the Botanical Gardens at Konigsberg, by Prof. E. Dorn.—On some periodical phenomena in inorganic nature, by Dr. Jentsch.—On the ancestors of hoofed animals and Edentata, by Dr. Albrecht.—On the rhythmical motions in the animal and in the human body, by Prof. Grunhagen.—On the fauna of New Zealand, by Prof. Zaddach.—On the archæopteryx, by Prof. Zaddach.—On the ancestors of rodentia, by Dr. Albrecht.

Bulletin de l'Academie Royale des Sciences (*de Belgique*), No. 12, 1880.—Application of the tuning-fork to study of the propagation of sound and vibratory movements in liquids, by M. Montigny.—On the falling stars of November 27, 1880, observed at Brussels Observatory, by M. Houzeau.—On two plesiosaurs of the lower lias of Luxembourg, by M. van Beneden.—Science and the imagination (lecture at public *séance*), by M. Stas.—Voyages and metamorphoses of a drop of water, by M. Van der Mensbrugghe.—Announcement of the results of prize competitions.—Reports on memoirs, &c.

Rivista Scientifico-Industriale, No. 1, January 15.—Singular verticillate configuration (in the form of a rose) of the laminæ of crystallised water, by Prof. Bombicci.—On storms, by Prof. Cantoni.—A modification of the Ruhmkorff coil, by Dr. Scarpa and S. Baldo.—Two new species in the Mediterranean fauna, by Prof. Richiardi.—Some ammonites of the middle lias, by S. Canavari.—Paramagnetism and diamagnetism of liquids, by Prof. Marangoni.—Experiments proving that air saturated with moisture is an insulator as well as dry air, by the same.

Journal de Physique, January.—Atmospheric absorption of ultra-violet radiations, by M. Cornu.—Experimental researches on the psychrometer, by M. Macé de Lépinay.—On the division of instantaneous currents, by M. Brillouin.—Electric *explorateur* of M. Trouvé, by M. Guriel.—M. Trouvé's apparatus for examination of deep natural or artificial cavities, by the same.—On resultant sounds, by M. Nicotra.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, February 3.—Prof. Owen read a third part of his description of the great extinct horned lizard of Australia (*Megalania prisca*). The materials had been transmitted from the same formation and locality-petrified drift-bed of King's Creek, Queensland, as the subjects of Part 2, and were discovered by Mr. Geo. Fred. Bennett, about thirty feet from the fossil skull. They proved to be, when recomposed, the opposite extremity of the animal, and consisted of an ossified sheath of the tail, in annular segments supporting conical cores of horn-like weapons. Of these segments the three terminal ones had coalesced; a fourth detached segment fitted the antepenultimate ring. Each ring, save the last, supported two pairs of horn cores, of which dimensions were given and drawings exhibited of the natural size. From tip to tip of the dorsal pair of the antepenultimate segment measured ten inches. In this segment was included the corresponding vertebra, exemplifying the caudal modifications of the type of the dorsal, sacral, and other vertebræ of *Megalania* described in the parts communicated to the Royal Society in 1858 and 1880. The author then entered into an exhaustive review of analogous caudal armatures in other animals. The nearest approach, in the class *Reptilia*, was made by the small existing Australian lizard (*Moloch horridus*) and by the *Uromastix princeps*, recently described by the late Arthur W. E. O'Shaughnessy, of whom Prof. Owen spoke in terms of deep regret and respect.

The supports of the caudal horns or spines in the above small lizards retained the immature condition of fibro-cartilage. Examples where histological development had proceeded to ossification were cited from recent and fossil *Reptilia*. In the latter the nearest approach to the caudal armature of *Megalania* was presented by the *Scelidosaurus*, of the Dorsetshire lias. A still nearer resemblance to the singular structures described in the present paper was made by certain extinct species of gigantic armadillos, e.g. *Glyptodon asper*, from South American tertiaries.

The author associated this repetition or lingering of a reptilian osteodermal character in the mammalian class with the previously-known repetition of the horny scutation of lizards in the mammalian pangolins (*Manis*); he referred to the low dental condition in the numerous similar simple teeth of armadillos and the still lower characters which had suggested the ordinal term "Edentata." He cited the tenacity of life and long continuance of the muscular irritability after death in the sloths; the winter sleep of bats and certain rodents, with their faculty of circulating blood in the venous state; the quills in hedgehogs and porcupines as indicative of a repetition of a dermal character of an oviparous class; the anatomical modifications giving a faculty of flight, as in Pterosaurians.

The sole common organic character of, and peculiar to, such members of a large and otherwise much varied group of mammals was a cerebrum, small, not extending upon the cerebellum, smooth or with few and simple convolutions, but with the hippocampal commissure ascending to connect the hemispheres above the lateral ventricles, and so constituting the anthropotomical "corpus callosum." A still lower group of mammals had no such commissural development, but this common cerebral character was associated with as many and great variations of inferior structures as in the *Lissencephala*. The *Lyencephala* included the marsupials and monotremes.

In the discussion which followed the reading of the paper the chief objection was an averment that the author had no evidence of its subjects having belonged to *Megalania prisca*, and that they were more probably parts of some Chelonian reptile.

To this the author replied that he had evidence both negative and positive. From the year 1857 he had received parts of the skeleton of a great terrestrial reptile from localities hundreds of miles apart in the provinces of New South Wales, Victoria, Queensland, but not a single fragment of a carapace, plastron, or other characteristic part of a Chelonian; every large reptilian fossil was not only "Lacertian," but of the very genus and species *Megalania prisca*. Perhaps no part of the axial skeleton was more differentiated than the occipital vertebra in a lizard and a tortoise. In the latter the elements remained as distinct as in a fish; in the former as confluent as in the mammal; this at least was the case in *Moloch* as it is in *Megalania*. Finally Prof. Owen pointed to the vertebra in organic connection with the tail-sheath in the fossils last received; it was Lacertian, not Chelonian.

"On a Method of Destroying the Effects of Slight Errors of Adjustment in Experiments of Changes of Refrangibility due to Relative Motions in the Line of Sight," by E. J. Stone, F R S, Director of the Radcliffe Observatory, Oxford

Let arrangements be made for the reversion of the prisms without any disturbance of the other optical arrangements, including, of course, the position of the cylindrical lens, if one be used Any slight errors of adjustment which prevent the light from the star and the comparison light from falling upon the train of prisms under the same optical circumstances, so far as mere direction is concerned, will have opposite effects in the reversed positions of the prisms, but the separation of the emergent lights due to relative motion will remain unchanged by the reversal of the positions of the prisms

If, therefore, the apparent change of refrangibility due to relative motion remains unchanged by the reversion of the prisms, all doubts about the effects of errors of adjustment will be removed But if the results in the reversed positions of the prisms sensibly differ, then the existing errors of adjustment must be removed, or their effects allowed for by taking a mean of the results in reversed positions, before any reliance can be fairly placed upon the determination of relative motions in the line of sight

A reversible spectroscope was arranged by me, and made by Mr. Simms, some years ago, but I have never since had an equatorial, with a good driving clock, under my control, with which the experiment indicated could be properly tried

With the direct prisms now in use the required reversion can be easily arranged I am not likely for some time to have the use of a good equatorial, and I therefore publish the plan with the hope that some one more fortunately situated may give it a fair trial

The experiment is a crucial one, and in my opinion should be tried.

Chemical Society, February 3.—Dr Gladstone, vice president, in the chair —It was announced that a ballot for the election of Fellows would take place at the next meeting of the Society —The following papers were read —On the estimation of organic carbon in air, by Drs Dupré and Hake. The carbon is converted into carbonic acid by passing the air over heated oxide of copper; the carbonic acid thus produced is absorbed by baryta water, and the carbonate is converted into sulphate which is weighed. The carbonic acid present in the air, as such, is estimated in a similar way and deducted The mean quantity of organic carbon in ten litres of ordinary London air was 0·000154; Boussingault and Verser found ten times as much The authors also refer to the results obtained by Pettenkofer in his well-known experiments on the elimination by animals of H and CH_4 Pettenkofer seems to have entirely neglected the organic carbon in the atmosphere, and thus his results require very important corrections.—On the action of the copper-zinc couple upon nitrates and the estimation of nitric acid in water analysis, by M W Williams. Some strips of clean zinc foil are placed in a wide mouth stoppered bottle and covered with a 3 per cent solution of copper sulphate when the zinc has acquired a sufficient coating of copper the solution is poured off and the copper zinc couple washed. The water to be analysed is then poured on the couple and allowed to remain for some hours at 24° C, after the addition of a little pure sodium chloride. The nitrates are thus completely converted into ammonia, which is estimated by nesslerising.—On the position taken by the nitro-group on nitrating the dibromo-toluenes, by R. Nevile and A Winther.—On some of the various derivatives of toluene and the toluidines, by R. Nevile and A. Winther

Anthropological Institute, January 25 —Anniversary Meeting.—Edward B. Tylor, F.R.S, president, in the chair — Dr. Tylor, the retiring president, gave the annual address on the year's progress of the science of man and civilisation. He described the excellent arrangements in the United States for supplying Indian agents, missionaries, and others in contact with native tribes, with manuals to guide them in collecting information as to laws, customs, languages, religion, &c, the very memory of which will die out with the present generation of Indians. He contrasted the active intelligence of the United States in this with the fact that the Dominion of Canada, though kindly and wise in their practical management of the Indians, do not seem alive to the value of the scientific knowledge which is being lost among them for want of a little cost and trouble in collecting it. Dr. Tylor also spoke of Prof. Flower's study of the mountaineers of Fiji, the Kai Colo, a race who have the narrowest skulls of all mankind The public have not yet become aware of the value of minute measurement of skull dimensions, but Prof. Flower has clearly shown in it a means of bringing the study of races under arithmetical calculation, a step which will do much to bring anthropology among the exact sciences —The new president is Major-General A. Pitt-Rivers, F R S

Physical Society, February 12 —Prof W. G. Adams in the chair.—This being the annual general meeting, the yearly report was read by the Chairman. The report showed that the Society now numbered 321 members as against 298 of last year Two eminent members, Sir T H Elliot and the Rev Arthur Rigg, had been lost by death The Society had decided to republish the scientific papers of Dr Joule in a collected form —Dr. Atkinson, treasurer, read the balance sheet for the past year, which showed the Society to be flourishing —The new Council and Officers were then elected, Sir W Thomson retaining the presidency —Mr Bakewell and Herr G Wiedemann were created Honorary Members —Votes of thanks were passed to the Lords Commissioners of the Council of Education for granting the use of the meeting room to the Society, to Prof. Adams and to Dr Guthrie, the demonstrator, the auditors, and the secretaries, Professors Rheinhold and Roberts —The meeting was then resolved into a special general meeting, and a resolution put and carried giving the Council power to invest money of the Society in the name of the Society, or of persons appointed by them, in certain stock, home and foreign —The meeting was then constituted an ordinary one, and Mr T Wrightson, C E., read a paper by Prof Chandler Roberts and himself on the density of fluid bismuth By means of the oncosimeter, an instrument which records on a band of paper the sinking or floating effect of a ball of the solid metal immersed in the molten metal, they had determined the density of fluid bismuth from six experiments to be 10 055 A former value by a different method was 10 039 In the discussion which ensued, Mr Wrightson stated that his experiments proved solid cast iron to be heavier than fluid, and to sink in the latter when first immersed, but it rapidly became lighter as its temperature rose, till it floated when in its plastic state, and was consequently lighter than when in the molten state The oncosimeter could be utilised for determining the change of volume in melting rocks, and Prof. Chandler Roberts suggested that it might throw light on the difference of state between the carbon of grey pig and white iron —Dr O J. Lodge exhibited working models showing the hydrostatic analogies between water and electricity. A battery was represented by a pump, conductors by open pipes, dielectrics by a pipe closed by an elastic membrane, electrometers by pressure gauges. With these analogues he showed the action of a Leyden jar, and the passage of telegraphic signals along a cable.

Geological Society, February 2.—Robert Etheridge, F R S, president, in the chair.—Joseph Groves, George Lewis, Rev. Edouard Méchin, S.J, James Osborne, and the Rev William Sharman were elected Fellows of the Society —The following communications were read —On the coralliferous series of Sind and its connection with the last upheaval of the Himalayas, by Prof P Martin Duncan, F R S —This communication is the result of the author's study and description of the fossil corals of Sind, undertaken at the request of the Geological Survey of India The history of the researches in the geology of the Tertiary deposits of Western Sind was noticed in relation to a statement made some years since by the author and Mr. H M Jenkins, F.G S., that there was more than one Tertiary series there, in opposition to both D'Archiac and Haime After a brief description of the geology of the Khirthar and Laki ranges of hills, which were called Hala Mountain by the French geologists, the succession of the stratigraphical series demonstrated by the survey under Blanford and Fedden was given, and the author proceeded to discuss the peculiarities of the six coral faunas of the area, and to argue upon the conditions which prevailed during their existence. A transitional fauna, neither Cretaceous nor Eocene, underlies a trap; to the trap succeeds a great development of Nummulitic beds containing corals, the Ranikot series, some of which are gigantic representatives of European Nummulitic forms A third fauna, the Khirthar, succeeds, and a fourth, Khirthar Nari, which was a reef-building one; and a fifth, the Nari, is included in the Oligocene age An important Miocene coralliferous series (the Gaj) is on the top of all. These faunas above the trap are Nummulitic, Oligocene, and Miocene in age, and in the first two European forms

which are confined to definite horizons, are scattered indefinitely in a vertical range of many thousands of feet. The corals grew in shallow seas, but most of them were not massive limestone builders, but there were occasional fringing reefs, or rather banks of compound forms, which assisted in the development of limestones. Many genera of corals which elsewhere are massive are pedunculate in Sind, and the number of species of the family Fungidæ is considerable There are also alliances with the Eocene coral fauna of the West Indies The depth of the coralliferous series and the intercalated unfossiliferous sandstones, &c, is according to the Survey, 14,000 feet, without counting an estimated 6000 feet of unfossiliferous strata in one particular group. The subsidence has therefore been vast, but not always continuous. After noticing the numbers of genera and species in this grand series of coral faunas and the remarkable distinctness of each, the author proceeded to discuss the second part of his subject When president of the Society he had stated in his anniversary address for 1878 that he was not convinced of the truth of the theory of the Geological Survey of India regarding the Pliocene age of the last Himalayan upheaval. The considerations arising from the position of a vast thickness of sedimentary deposits overlying the Gaj or marine Miocene, and containing *Amphicyon*, *Mastodon*, *Dinotherium*, and many Artiodactyles of the supposed pig-like ruminant group, lead to the belief that the author was not justified in opposing the theory enunciated by Lydekker and the directors of the Survey The position of these Manchhar strata on the flanks of the mountain system of Sind was compared with that of the sub-Himalayan deposits. The faunas were compared, and the Sewalik deposits, the equivalents of the Upper Manchhar series of Sind, were pronounced to be of Pliocene age They were formed before and during the great upheaval of the Himalayas, and in some places are covered with glacial deposits A comparison was instituted between these ossiferous strata and the beds of Eppelsheim and Pikermi, and the author discussed the question relating to the age of terrestrial accumulations overlying marine deposits —On two new crinoids from the Upper Chalk of Southern Sweden, by P H Carpenter, M.A Communicated by Prof P. Martin Duncan, F R S Stem joints of a crinoid resembling those of *Bourguticrinus* have long been known in the Planerkalk of Strehlen (I lbe), but on the discovery of the calyx it was found to differ considerably from that genus. It was then referred to the genus *Antedon* by Prof Geinitz. Stems also resembling *Bourgueticrinus* have been found in the upper chalk of Kopinge (S Sweden), and a calyx resembling that described by Prof Geinitz has also been found Prof Lundgren kindly entrusted this to the author for description. For these two fossils he considers not only a new genus but also a new family required He proposes for the former the name *Mesocrinus*, as the characters of its calyx ally it to the Pentacrinidæ The author describes the characteristics of the genus *Mesocrinus* and of the species *M suecica* (the Swedish) species, and its differences from *M fischeri* (from Strehlen), and discusses the relationships of the genus, which combines the characters of a *Pentacrinus*-calyx with a *Bourgueticrinus*-stem —A new species of Comatula (*Antedon impressa*) from the Ignaberga limestone of Scania was also described, and its systematic position discussed.

Entomological Society, February 2 —Mr H T Stainton, president, in the chair.—The president thanked the Society for electing him to that office, and nominated Sir John Lubbock, Bart., and Messrs Meldola and Distant as vice-presidents for the ensuing year Two new members were then elected —Exhibitions and communications —Mr O Salvin exhibited two boxes of insects collected by Mr Champion in Guatemala —Mr W A Forbes exhibited a leaf from New Britain, having a curious filamentous growth upon it, caused by a *Coccus*, and also the larva of one of the *Blattidæ*, from Pernambuco, which presented a remarkable resemblance to an Isopod crustacean —Mr. R. McLachlan exhibited a coleopterous larva from South America attacked by a fungoid parasite (*Sphæria*), and a *Noctua* from South Wales similarly attacked by an *Isaria*. He also exhibited *Thore concinna*, a beautiful new dragon fly from Ecuador.—Mr. T R. Billups exhibited *Pezomachus distincta*, a hymenopterous insect new to Britain; and a new species of *Stibentes*.—Mr. F P Pascoe exhibited a specimen of *Peripatus Novæ-Zealandiæ*, and made some observations on the structure and affinities of this anomalous genus —Mr W L Distant exhibited a new species of *Platypleura* from Madagascar.—Mr W F. Kirby announced the death of Dr. Gabriel Koch, of Frankfort-on-the Main, the author of several works on the geographical distribution of *Lepidoptera*.—Mr. R. Meldola read a letter from M André in reply to some criticisms made at a former meeting of the Society respecting the publication of new species on the wrapper of a periodical work.—The Secretary read a cutting from an Australian newspaper, communicated by Mr G. Giles, relative to the death of a child, in consequence, as was supposed, of the bite of a small spider.—Papers read —Mr A. G. Butler communicated a paper entitled "Descriptions of new genera and species of Heterocerous *Lepidoptera* from Japan."—Mr. R. McLachlan read some notes on *Odonata* of the sub families *Cordulinæ*, *Calopteryginæ*, and *Agrioninæ* (Legion *Pseudostigma*) collected by Mr. Buckley in the district of the Rio Bobonaza in Ecuador —Mr W F. Kirby read a list of the Hymenoptera of New Zealand, in which eighty two species were enumerated, five being described as new —Mr Joseph S. Baly communicated a paper entitled descriptions of new species of *Galerucidæ*

Victoria (Philosophical) Institute, February 21 —A paper on the implements of the Stone age as a primitive demarcation between man and other animals, by Dr Thompson, LL D, of Harvard University, was read, after which a second brief paper on the caves of Devonshire was read by Mr Howard, F R S, in which the author, as a chemist, pointed out the important bearing that the new investigations into the mode of formation of the cave floor had upon the whole question at issue

VIENNA

Imperial Academy of Sciences, February 17.—V Burg in the chair —Prof Schmarda presented a paper by Henry B Brady, F R S, on Arctic foraminifera from soundings obtained on the Austro-Hungarian North Pole Expedition of 1872-74 It will be published in the *Denkschriften der Academie*.—F. Steindachner, ichthyological materials (part 10)—F Wald, studies on chemical processes producing energy —F Brucke, supplement to his communication of January 7 on an uncrystallisable acid obtained by oxidation of egg albumen It is not a pure substance, but a mixture —E Weiss, on the computation of the differential quotients of the radius vector and the apparent anomaly in orbits of great excentricity —T V Rohon, on *Amphioxus lanceolatus* —Dr Zd H Skraup, on synthetical experiments in the Chinolin series.

CONTENTS

THURSDAY, MARCH 3, 1881

NATURAL CONDITIONS AND ANIMAL LIFE

The Natural Conditions of Existence as they Affect Animal Life. By Karl Semper, Professor in the University of Würzburg. International Scientific Series. (London: Kegan Paul and Co., 1881.)

THIS is in many respects one of the most interesting contributions to zoological literature which has appeared for some time. The author is well known as an accomplished anatomist and microscopist who, after spending some years in exploring the fauna of the Philippine and neighbouring islands, returned to Europe, and having been appointed to the Chair of Zoology in Würzburg, set himself to work at the morphological problems which so largely occupy at present the attention of anatomists. His most remarkable productions in this department have been his speculations and observations on the segmentation of animals and on the origin of the vertebrate kidney. But Prof. Semper has the advantage of being something more than an anatomist: as a traveller and one who has seen and studied life under most varied conditions, he has thought much and collected many facts bearing upon the problem of the influence of changed conditions of life in modifying the structure of animals submitted to those conditions.

With the leading theoretical consideration advanced by Prof. Semper no naturalist who knows the history of evolutional theory will agree, but the large collection of well described and well illustrated facts for which he claims attention in consequence of his theoretical preconceptions, are none the less interesting. The book has the great merit of being one which will be found equally readable by the professed zoologist and by the general reader.

Prof. Semper, whilst accepting the doctrine of the origin of new forms of life by the natural selection of fittest varieties of pre-existing forms, is unable to conceive of the "fittest varieties" in question, being such slightly divergent forms as are normally to be found in the offspring of all parents. Though he does not explicitly deny the physiological importance of even such minute variations as are not readily perceived by the human eye, and consequently does not openly controvert Mr. Darwin's theory to the effect that such of these minute variations as are fitted to given conditions of existence, are perpetuated and intensified by the survival of those animals in which they occur, and the failure and death of those in which they do not occur, yet Prof. Semper is among those who look for a more rapid and conspicuous method of the production of new species than that taught by pure Darwinism. He thinks that Mr. Darwin has overlooked or underrated the importance of "*directly transforming agents*." He is no doubt aware that it is equally possible to over-estimate the importance of such action, and that this was done by Mr. Darwin's predecessors. Accordingly he examines in the volume before us such cases as may tend to give evidence on the subject.

Such cases are to be found when an animal living upon special food, or in given temperature, or light, or in water (still or running, fresh or saline), or air (dry or moist, still or breezy), or in isolation, or as parasite, is subjected to a change in those conditions either by natural processes or by experiment. A large series of natural instances are afforded by pairs of representative species of one genus, the one living under one set of conditions, the other under conditions in which the factor, the influence of which is sought, is seen very largely altered. Very few experiments, as Prof. Semper remarks, have been made upon this subject, but some of remarkable interest are cited.

The result of the examination of the instances which have been gathered together in this volume is *not* such as to lead to the conclusion that directly transforming agents play an important part in the production of new species. "Changed conditions," Mr. Darwin has said, "induce an almost indefinite amount of fluctuating variability by which the whole organism is rendered in some degree plastic," and it is to the non-significant variations so produced which are selected by survival and fixed by heredity that new forms are due, and not to those *habit* adaptations effected in the individual by changed conditions which are remarkably rare, and moreover, as Prof. Semper recognises (p. 38), are not transmitted, as a rule, to offspring. In order to establish his point Prof. Semper should have been able to give us, firstly, numerous instances of change of structure in the individual brought about in adaptation to a change in that individual's conditions of life. He produces very few, whilst the most striking and numerous facts which he records are instances of physiological adaptation to or toleration of new conditions *without any corresponding change of structure*. Secondly, he should have been able to give instances of the transmission to offspring of peculiarities acquired by the parent by undoubted action of the environment on the individual parent. Such instances are excessively rare, though a few are on record, but none are cited by Prof. Semper, and indeed the evidence as at present before us is such as to warrant the conclusion that such transmission cannot be in any way an important factor in the production of new races.

In his concluding paragraph (p. 405) Prof. Semper states that "there is a universal difficulty of deciding whether a modification which has taken place is to be ascribed to some direct determining and modifying cause, or to the enhancing of a previously modified character which is frequently connected with selection," and then deprecates the habit of theoretical explanations from general propositions. He holds apparently that we are not to seek an explanation of such modifications in those truths of heredity and adaptation, of variation and selection, which have been actually demonstrated and established by Mr. Darwin, but must, if we would behave as right minded philosophers, keep before us the possibility of these modifications being due to—what? Not to a cause which has been shown to be necessarily or even usually at work, as have those to which Mr. Darwin points, but to a cause which has always proved illusory, namely, the "directly transforming" action of the environment. It was because they appealed to this cause and could not show that it had a real existence that the "transformists" of the beginning of this century failed, where Mr. Darwin, appealing to another cause which he showed was an existing cause, has succeeded. Prof.

Semper's contribution to the subject does not tend to alter the low estimate which has been formed of the efficiency of directly-transforming agents, nor to justify the "final warning" which closes his book. It is then as a repertory of physiological facts of a kind usually neglected both by the professed physiologist and by the professed zoologist that this book will be found of value, not as the expository of new or of old theory

After an introduction in which, amongst others, some interesting observations on the casting of the skin of reptiles and of crayfish are given with illustrative cuts, we find a chapter on "Food and its Influence." The variety of mineral and organic substances which constitute the food of animals is noted, and monophagous and polyphagous animals distinguished, curious adaptations to a special food such as that of egg-eating snakes, with their gastric teeth formed by processes of the vertebræ, are cited, and some remarkable examples of change of diet naturally occurring in a species *without any modification of structure, e g.* the New Zealand parrot, which used to feed on the juices of plants and flowers, but now sucks the blood of sheep Again, horses eating pigeons, vegetivorous snails (Lymnæus) eating young newts, crocodiles, some eating men, and others of the same species not prone to the habit The only well-established instances of modification of structure caused by change of food are due to John Hunter, who fed a gull for a year on grain, and so hardened the inner coat of the bird's stomach as to make it resemble the gizzard of a pigeon; whilst Dr Holmgren is cited as having obtained the converse result by feeding a pigeon on meat The change brought about here is, however, not strictly speaking a change of structure, but rather a modification of the chemical activity of the gastric epithelium.

Many instances of wide difference of diet in closely allied species of animals not accompanied by any corresponding difference of structure are given in the text and in the valuable notes at the end of the book.

The influence of light is next discussed, and we have some statements as to the difference in their relation to light, of plants and animals Prof Semper does not admit the presence of chlorophyll in any animal, and goes so far as to say that the similarity of the spectrum of the solution of the green pigment of an animal with that of chlorophyll would not prove the pigment to be chlorophyll. If by "similarity" exact correspondence is meant, we should differ from him; but it is no doubt true that further exact observation is needed of those cases among invertebrate animals in which chlorophyll has been supposed to be present

Semper holds that there is a high degree of probability in the view that the green-coloured bodies present in some lower animals in such abundance are really parasitic Algæ like the gonidia of lichens As an argument in favour of this view he adduces Max Schultze's observation that the "chlorophyll-bodies" of the worm *Vortex viridis* divide and multiply spontaneously, which he states (in opposition to the generally received observations of Nageli and the statements of his colleague Sachs) the chlorophyll bodies of plants do not It would be interesting if this should prove to be the case, and if Prof Semper should be destined to reform our notions of Vegetable histology among other things.

In a note Semper attacks Paul Bert for saying that "Infusoria containing green matter decompose carbonic acid in the same way as vegetable cells" The French physiologist is well within the facts, for Priestley's green matter was the Flagellate *Euglena viridis*.

It is necessary to point out that it is by no means proved by Cienkowski's observations that the yellow cells of Radiolaria are parasitic one-celled Algæ, as Semper assumes, though it is possible that such is their nature.

Light affects animals mostly through the eye only, and its intensity undoubtedly has a modifying influence upon that organ, but whether the degeneration of the eye in cave animals and deep-sea Fishes and Crustacea is due *directly* to disuse in any instance or to altered selection and heredity, is not clear. Many important facts and some good drawings bearing on this matter are given Dr Hagen informed the author that in all the species of cave-beetles of the genus Machærites the females *only* are blind, while the males have well-developed eyes, although both live together in total darkness, whilst it is well known that many blind animals, *e g.* certain Mollusks, Crustacea, and Worms, live in bright daylight.

Facts are cited showing that the colours of animals are not developed by or dependent on light, whilst the change of colour effected by cuttle-fish, fishes, and Amphibia when light acts on the eye are discussed at length, and the researches of Lister and of Pouchet cited Prof. Semper, in common with other naturalists, explains the difficulty presented by the colouration of some animals, such as those which live in the dark (many marine polyps and worms), by the assumption that the pigment is the inevitable secondary product of some indispensable physiological process The same explanation is applied to the phosphorescent material of many marine organisms, which is apparently useless or even injurious to the animals which produce it

Temperature affords subject-matter for a chapter, abounding in important records of fact, which are, it must be admitted, quite antagonistic to the notion that variations in the environment in this respect can directly produce *adaptative* change of structure. The most remarkable instance of temperature effecting a change of structure is that quoted from Weissman, who, by artificially lowering the temperature, succeeded in rearing *Vanessa levana* from the eggs of *Vanessa prorsa-levana*, the two supposed "species," being only winter and summer varieties of one. But here, though the colouring is different in the two varieties, there is no adaptational character about it, nor a transmission of the changed colouring to offspring.

A number of facts are cited as to the supposed change of colour of Arctic animals in winter, but the conclusion seems to be that no such change occurs. Facts establishing the possibility of freezing whole fish and other animals are given, and other facts showing that 5° below 0° C. kills the tissues of such animals as frogs, and may thus cause death to the whole animal. Important researches of Horvath are cited, showing that the Ground-squirrel (Spermophilus), the temperature of whose body is in summer like that of man, about 38° C., can, during its winter sleep, sink to as low a temperature as 2° C. without injury; its body, in fact has, at this period, the same temperature as that of the surrounding air. The

rabbit, on the other hand, is infallibly killed when the temperature of its body is reduced to 15° C The glacier flea (*Desoria glacialis*, one of the Thysanura) is cited as an example of an animal taking up by preference, as it were, a permanently cold life-arena; whilst as examples of endurance of high temperatures we have Crustaceans found in hot springs of 60° C, and fish (Sparus) in hot springs of 75° C The acclimatisation of Mr. Buxton's parrots in Norfolk is described at length, and amongst many other details of the kind concerning the influence of temperature on the spawning and hatching of eggs of various animals, the fact is recorded that at 10°·5 C. the common frog requires 235 days to pass from the egg through complete metamorphosis, whilst at 15°·5 C. only 73 days are required "Nothing in the Philippine Islands struck me so much," Prof Semper writes, "as to observe that there all true periodicity had disappeared even from insects, land mollusks, and other land animals, I could at all times find eggs, larvæ, and propagating individuals, in winter as well as in summer" An important reflection in this connection is the following:—"It is generally assumed that we are justified in attributing to extinct animals a mode of life analogous to that of the nearest related surviving forms; . . as soon as we reach the deeper strata, and the identity of the species with those now living ceases, our right to construct a theory of the climate of past epochs by a comparison of fossil and living species, absolutely disappears" How far, it may well be asked, is this true when plants are substituted for animals?

In a chapter on "The Influence of Stagnant Water" we have a large series of interesting facts and records of experiment under the headings "Freshwater Animals that Live in the Sea" and "Marine Animals in Fresh Water" In both these categories we find a number of animals, whilst as a matter of experiment it is found that, though very few animals will endure *sudden* transference from fresh to saline water, or *vice versâ*, yet a large number will tolerate the change if it be accomplished by slow degrees, whilst others will not endure it, however brought about The same effect of gradation is noted with regard to change of temperature But in neither the one case nor the other is Prof Semper able to cite an instance which tends to favour the view that direct modification of structure is produced by such changes of life conditions

The instances cited, though not so distinguished by Prof Semper, may be divided into those afforded by certain species living in one kind of water (fresh or salt), whilst the other species of the genus live in the other kind of water, and secondly, those afforded by exceptional individuals naturally found in one kind of water, whilst normally the individuals of the *same* species occur in the other kind of water. Results derived from the experiment of gradual transference from one kind of water to the other would form a subdivision under this second head The rare instances of animals living in brine may also be classified in the same manner. Many species allied to river-worms and earth-worms (Oligochæta) are now known to occur in the sea; also Crustacea allied to freshwater forms. Sea-insects and sea-spiders (like [the common fresh-water diving spider) are cited in the valuable list of references given at the end of Prof Semper's book, and such characteristically fresh-water mollusks as Cyclas, Unio, and Anodonta (found living in the Livonian Gulf with Tellura and Venus). Paludina and Neritina are found living in the Caspian with Mytilus and Cardium *Planorbis glaber*, in 1415 fathoms in the Mediterranean. Many freshwater species of fishes are recorded from marine waters, and the whole group of sea-snakes form an example in point

Of marine animals living in fresh-water we have, besides the polyp, *Cordylophora lacustris* (of which some interesting facts, showing its historical advance into fresh-waters, are given by Prof Semper), and the new jelly-fish Limnocodium, and other jelly-fish and polyps living in estuarine conditions (see *Quart Journ of Microsc Science*, October 1880, for observations by Agassiz and Moseley), some Bryozoa of marine affinities, *e.g* Membranipora, some Nemertines, and one cephalobranchiate Annelid, numerous Crustacea, such as Balanus, Mysis, Palæmon Among Mollusks Pholades and Teredines are recorded from fresh-water, their congeners being marine, whilst actual marine species of fish (the grey-mullet and the basse) have been bred successfully for the market in the fresh-water Lake of Acqua, near Padua. The common stickleback, as is well known, can be kept in a marine aquarium Migratory fish such as the salmon are further examples

The experiments of Beudant and Plateau on the influence on animals of the change of saline to fresh-water or *vice versâ* are given in detail, and both are of great interest Beudant's experiments were made with two series of molluscs—a fresh-water series transferred to salt-water, and a salt-water series transferred to fresh-water The Pulmonata and species of Paludina were found to be very tolerant of sea-water, whilst Unio, Anodonta, and Cyclas were all eventually killed by it *Patella vulgata*, *Purpura lapillus*, *Arca barbata*, *Venus maculata*, and *Ostrea edulis* survived in large proportion the gradual transference to absolutely fresh-water, whilst of *Mytilus edulis* not a single specimen died in the course of the experiments, species of Fissurella,' Haliotis, Buccinum, Tellina, Pecten, and Chama were, on the other hand, killed by the same process

For full reference to sources of information on this and all the many interesting observations recorded we must refer the reader to Prof Semper's book

In successive chapters we have similar details as to the influence of dry air, of currents of water, and of change of life from aquatic to terrestrial conditions, the land leeches, land planarians, land crabs, and land fishes being described and sometimes figured

Some very remarkable observations on pulmonate snails living in the Lake of Geneva made by M. Forel and by Dr. Pauly are given at length on pp 197, 198 Certain Lymnæi live at great depths in the lake with their lung-sac filled with water; they never come to the surface, and actually breathe water all their lives, but if brought to the surface they take air into the lung sac and will not again return to the submerged existence. If forced to do so they retain air in their lung sac and breathe water by the general surface of the body "In no single case," Prof. Semper frankly observes "have we as yet succeeded in proving that such change of function as is involved in the transformation of a gill-

cavity into a lung must necessarily be accompanied by definite changes in the structure of that organ"

After chapters expounding Prof Semper's original observations and special theory as to the formation of coral islands, in which he characteristically seeks to improve upon Mr. Darwin, and a chapter upon the influence of parasitism, we come to a final chapter entitled "The selective influence of living organisms upon animals" Here new facts bearing upon the competition for similar conditions, the relations of the pursuer and the pursued, and mimicry, are set forth in abundance. The curious dorsal eyes of the marine slug Onchidium are described and figured, and an ingenious attempt is made to account for their evolution in relation to the pursuit of the Onchidium by the leaping-fish Periophthalmus Prof Semper is not blundering when he states that these eyes are constructed on what he calls "a type identical with those of the vertebrata" At the same time such a statement is very misleading, for these eyes differ essentially in their origin and structure from those of vertebrates, although having one superficial resemblance to the vertebrate eye in the fact that the retinal nerve is distributed to the anterior instead of to the deep surface of the retinal cells This arrangement exists also in Pecten, contrary to Prof Semper's statement that Onchidium is a solitary example of its occurrence in invertebrata

As to mimicry Prof Semper brings forward a new instance among land-snails where a Philippine Helicarion which sheds its tail (metapodium) and so escapes when seized by a bird or lizard, is imitated closely in appearance by a Xesta which has not the power of shedding its tail, but benefits by the reputation for elusiveness of the Helicarion On the general subject of mimicry Semper does not consider the doctrine of selection adequate, but thinks it necessary to improve the current theory relating to it by some original touches He has made the not very new discovery that "under some circumstances the most perfect and complete resemblance between two creatures not living associated may originate without its being referable to the selective power of mimicry, *i.e.* a protective resemblance" The resemblance referred to is of course a superficial one of colour or appearance of one part of the body, and not really "perfect" or "complete" From this he goes on to suggest that subsequently to this stage a necessity for protection may arise, and the previously-established resemblance *may* become protective to one or other of the reciprocally counterfeit organisms. On the strength of this suggestion he proceeds further to question whether natural selection has ever produced mimicry, and declares that some causes "*must* have availed to produce by their direct action an advantageous and protective change of colouring" in the first instance Similar to this, he states, is the conclusion which is arrived at in each chapter of his book in reference to other adaptations besides those coming under the head of mimicry, viz. that natural selection cannot operate until directly transforming agencies have produced advantageous characters of a definite and obvious kind upon which it may operate.

With the whole of this reasoning, and especially with the statement that any such conclusion can be derived from the facts stated in earlier chapters, we disagree. On the contrary, we maintain that natural selection operates upon advantageous variations which are exceedingly small, and do not, by an immense interval, amount to such coarse advantages as those assumed by Prof. Semper Such small variations are incessantly caused by the action of external forces on the complex physiological units of the parents and by the action of those of one parent upon those of another These causes of variation are not transforming causes, but produce irrelative and multifarious variations of small amount. It is upon these that natural selection acts The existence of such variations, the power of selection to intensify them, and so to transform species and further the natural existence of a necessary selection, have been established by Mr. Darwin by an enormous mass of evidence. Prof Semper, so far from having brought his reader in each chapter to a conclusion favourable to his views, has not adduced any evidence to show that natural selection cannot or does not act as taught by Mr. Darwin, and has moreover completely failed to adduce any evidence making it even probable that large changes of structure are ever effected by "directly transforming agents," of the very existence of which he can offer no evidence Still less has he succeeded in showing that natural selection does or even that it could make use of such large changes—concerning which it is difficult to reason, since nothing is known about them excepting that Prof Semper believes in them [1]

The supposed cases of minute resemblance without mimicry which are given by Semper are either to be explained as due to a protective resemblance to a third object, or as due to like advantages secured independently in each case by natural selection in a way which may become apparent when we have more ample knowledge of the particular cases, or lastly, as due to an accidental superficial identity in two things having absolutely no relations in common To argue that the last account of the matter is the true one, and that the elaborate mimicry of insects is to be explained with the assumption of the frequent occurrence of such coincidences rather than by the doctrine of natural selection, is, it may be conceded,

[1] It is necessary to plainly and emphatically state that Prof. Semper and a few other writers of similar views (*e.g.*, the Rev George Henslow in *Modern Thought*, vol ii No 5, 1881), are not adding to or building on Mr Darwin's theory but are actually opposing all that is essential and distinctive in that theory by the revival of the exploded notions of "directly transforming agents" advocated by Lamarck and others They do not seem to be aware of this, for they make no attempt to seriously examine Mr Darwin's accumulated facts and arguments The doctrine of organic evolution has become an accepted truth entirely in consequence of Mr Darwin having demonstrated the mechanism by which the evolution is possible, it was almost unanimously rejected, whilst such undemonstrable agencies as those arbitrarily asserted to exist by Prof Semper and Mr George Henslow were the only causes suggested by its advocates Mr Darwin's argument rests on the *proved* existence of minute many-sided, irrelative variations *not* produced by directly transforming agents, but showing themselves at each new act of reproduction as part of the phenomenon of heredity Such minute "sports" or "variations" are due to constitutional disturbance, and appear not in individuals subjected to new conditions, but in the offspring of all, though more freely in the offspring of those subjected to special causes of constitutional disturbance Mr Darwin has further *proved* that these slight variations can be transmitted and intensified by selective breeding They have in reference to breeding a remarkably tenacious or persistent character, as might be expected from their origin in connection with the reproductive process On the other hand mutilations and other effects of directly transforming agents are rarely, if ever, transmitted

It is little short of an absurdity for persons to come forward at this epoch, when evolution is at length accepted solely because of Mr Darwin's doctrine, and coolly to propose to replace that doctrine by the old notion so often tried and rejected

That such an attempt should be made is an illustration of a curious weakness of humanity Not unfrequently, after a long-contested cause has triumphed and all have yielded allegiance thereto, you will find when few generations have passed that men have clean forgotten what or who it was that made that cause triumphant, and ignorantly will set up for honour the name of a traitor or of an impostor, or attribute to a great man as a merit, deeds and thoughts which he spent a long life in opposing

original and startling; but it involves a deliberate renunciation of the exercise of reason.

The translation of Prof. Semper's highly entertaining and really valuable and suggestive book has been remarkably well executed Throughout great care has been taken to give the correct English equivalents for the German names of many obscure animals, and to preserve the sense of the original. At the same time there is not from beginning to end any trace of that awkward diction which sometimes infects a translation from the German. It is not too much to say that it is the best executed translation of a foreign work on science which has appeared for twenty years. E. RAY LANKESTER

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications*

The Editor urgently requests correspondents to keep their letters as short as possible The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Movements of Plants

FRITZ MULLER, in a letter from St Catharina, Brazil, dated January 9, has given me some remarkable facts about the movements of plants He has observed striking instances of allied plants, which place their leaves vertically at night, by widely different movements; and this is of interest as supporting the conclusion at which my son Francis and I arrived, namely, that leaves go to sleep in order to escape the full effect of radiation In the great family of the Gramineæ the species in one genus alone, namely Strephium, are known to sleep, and this they do by the leaves moving vertically upwards; but Fritz Muller finds in a species of Olyra, a genus which in Endlicher's "Genera Plantarum" immediately precedes Strephium, that the leaves bend vertically down at night.

Two species of Phyllanthus (Euphorbiaceæ) grow as weeds near Fritz Muller's house, in one of them with erect branches the leaves bend so as to stand vertically up at night In the other species with horizontal branches, the leaves move vertically down at night, rotating on their axes, in the same manner as do those of the Leguminous genus Cassia. Owing to this rotation, combined with the sinking movement, the upper surfaces of the opposite leaflets are brought into contact in a dependent position beneath the main petiole; and they are thus excellently protected from radiation, in the manner described by us. On the following morning the leaflets rotate in an opposite direction, whilst rising so as to resume the diurnal horizontal position with their upper surface exposed to the light. Now in some rare cases Fritz Muller has observed the extraordinary fact that three or four, or even almost all the leaflets on one side of a leaf of this Phyllanthus rise in the morning from their nocturnal vertically dependent position into a horizontal one, without rotating, and on the wrong side of the main petiole. These leaflets thus project horizontally with their upper surfaces directed towards the sky, but partly shaded by the leaflets proper to this side. I have never before heard of a plant appearing to make a mistake in its movements; and the mistake in this instance is a great one, for the leaflets move 90° in a direction opposite to the proper one. Fritz Muller adds that the tips of the horizontal branches of this Phyllanthus curl downwards at night, and thus the youngest leaves are still better protected from radiation.

The leaves of some plants, when brightly illuminated, direct their edges towards the light, and this remarkable movement I have called paraheliotropism Fritz Muller informs me that the leaflets of the Phyllanthus just referred to, as well as those of some Brazilian Cassiæ, "take an almost perfectly vertical position, when at noon, on a summer day, the sun is nearly in the zenith. To-day the leaflets, though continuing to be fully exposed to the sun, now at 3 p m. have already returned to a nearly horizontal position." F. Muller doubts whether so strongly marked a case of paraheliotropism would ever be observed under the duller skies of England; and this doubt is probably correct, for the leaflets of *Cassia neglecta*, on plants raised from seed formerly sent me by him, moved in this manner, but so slightly that I thought it prudent not to give the case With several species of Hedychium, a widely different paraheliotropic movement occurs, which may be compared with that of the leaflets of Oxalis and Averrhoa, for "the lateral halves of the leaves, when exposed to bright sunshine, bend downwards, so that they meet beneath the leaf" CHARLES DARWIN

Down, Beckenham, February 22

Barometric and Solar Cycles

REGARDING one of the conclusions drawn by Mr. F. Chambers in his paper on "Abnormal Variations of the Barometer in the Tropics," and Dr Balfour Stewart's remarks concerning the same in the first article of NATURE (vol xxiii, p 237), I and other meteorologists would like very much to know which side of the earth is to be considered the east, and which the west

In other words, if waves of high barometer travel slowly from west to east, on what meridian do they commence, and is there any reason why they should commence on one meridian more than on another? The only reason that I can think of is that some meridians embrace more land than others; but in this respect the meridians passing through the centres of America, Europe-Africa, and East Asia-Australia are very much alike Again, if barometric changes originate, say at St Helena, and travel slowly eastwards, as Mr Chambers supposes, they ought after several months to reappear on the meridian from which they started, but Mr. Chambers's paper gives no evidence of this whatever.

Dr Balfour Stewart says it is unmistakably indicated by all the elements that the connection between the state of the sun's surface and terrestrial meteorology is of such a nature as to imply that the sun is most powerful when there are most spots on his surface. The barometric evidence, however, is all the other way.

Mr Blanford, following up a suggestion originally made by the present writer, has shown clearly enough that the decennial variation of the height of the barometer has nearly opposite phases in the Indo-Malayan region and in Western Siberia, especially if the winter season, when the pressure is higher over Siberia than in South-Eastern Asia, be considered alone (NATURE, vol xxi p 480). From Mr Blanford's paper it is clear that the barometrical differences, on which the strength of the winds depends, are greater when the sun spot area is small than when it is large.

The true relation between the variations of sun spot area, solar radiation, and barometric pressure will, I feel confident, be soon discovered through the agency of the United States Weather Maps in the manner pointed out by you at page 567, vol xxi, in discussing the United States Weather Map for July, 1878. It is there shown that in the middle of summer in the last year of minimum sun spot, the pressure of the air was below the average over all the great continents, and above it over the neighbouring oceans In India, it is true, the pressure was above the average, but then India is not Asia, but merely a narrow triangular peninsula surrounded on two sides by the ocean, and on the third by a broad zone of snow covered mountains which may be likened to an oceanic area as far as constancy of temperature is concerned.

Meteorologists will all agree with Dr Balfour Stewart that "unexceptionable observations of the sun's intrinsic heat-giving power, if these could be obtained, would furnish a more trustworthy instrument of prevision than the sun-spot record." We may soon hope for a nearly continuous series of such observations, for, according to the last published Administration Report of the Indian Meteorological Department, a trustworthy form of actinometer is being sent to Leh, 11,500 feet above the sea, in the dry region of Tibet, where observations will be taken with it under the superintendence of Mr. Ney Elias.

Meantime we may perhaps adopt what is considered by Mr. Blanford the best criterion of the sun's heating power which can be obtained from ordinary meteorological observations, viz the highest excess of the vacuum black-bulb thermometer above the maximum in shade for each month At ten stations in India where comparable thermometers have been used since 1875, the mean maximum solar excess has been:—

1875	1876	1877	1878
67°·0	67°·2	68°·8	68°·1

The means of thirty-eight stations since 1876 give similar results, viz.:—

1876	1877	1878
68°·2	68°·8	68°·3

For 1879 and 1880 the figures have not yet been all worked up, but as far as they have been reduced they indicate that the intensity of solar radiation was a good deal less than in 1878.

Allahabad, February 3 S. A. HILL

The Continents always Continents

MR. WALLACE, in his recent excellent work on "Island Life," places me in a wrong relation to the question as to the continents having always been continents. After sustaining the view at length in Chapter VI. of his work, without any reference to my arguments on the subject, he later, in Chapter IX., says that "it appears to be the general opinion of geologists [*sic*] that the great continents have undergone a process of development from earlier to later times," and then quotes a paragraph of mine by way of proof.

My first discussion of the subject was published in the *American Journal of Science* for 1846 (vol. ii. of second ser. p. 352), where the "opinion" is partly speculative, the origin of the continents being made one of the initial results of the earth's refrigeration; but it is not left without the mention of facts sustaining it derived from the actual geological progress of the American continent. In the following volume, in an article entitled "On the Origin of Continents," the view is presented at more length, with some additional confirmatory facts connected with the structure of the continent; and facts from the earth at large bearing the same way are brought out in a second paper, "On the Origin of the Grand Outline Features of the Earth." In my "Geological Report" (published in 1849) of the Wilkes Exploring Expedition around the World, in which the same views are briefly presented (p. 431), I argue against "the existence of a continent in the Pacific Ocean within any of the more recent geological epochs" [referring here to those of the Tertiary and Quaternary], on the ground of "the absence of all native quadrupeds from its islands, and even from New Zealand."

A few years later (in 1856) I published, in vol. xxii. of the *American Journal*, two papers under the titles "On American Geological History" and "On the Plan of Development in the Geological History of North America," and in them I gave what I have regarded as a geological demonstration of the view by stating with some detail the facts with respect to the successively-developed features and geological formations of the American continent. Again, in my "Manual of Geology," the first edition (that of 1863), the progress of the rocks and mountains of the continent is traced out, from the V-shaped Archæan (Azoic) nucleus, in British America, onward; and in the account of the Archæan the statement is made (p. 136) that the structure lines apparent over the continent at the close of Archæan time were "features that were never afterwards effaced; instead of this, they were manifested in every new step in the progress of the continent"; and in the edition of the Manual of 1874, after a fuller account of the positions of Archæan mountains, it is then added (p. 160): "Hence, in the very inception of the continent, not only was its general topography foreshadowed, but its main mountain chains appear to have been begun, and its great intermediate basins to have been defined—the basin of New England and New Brunswick on the east; that between the Appalachians and the Rocky Mountains over the great continental interior; that of Hudson's Bay, between the arms of the northern V. The evolution of the grand structure-lines of the continent was hence early commenced, and the system thus initiated was the system to the end. Here is one strong reason for concluding that the continents have always been continents; that, while portions may have at times been submerged some thousands of feet, the continents have never changed places with the oceans. Tracing out the development of the American continent from these Archæan beginnings is one of the main purposes of geological history." In the course of the following pages (nearly 400) on Historical Geology in both editions, the evidence on this point is variously set forth—evidence afforded by the limits of the successive geological formations, by the occurrence of beds of shallow-water deposition at many levels in the long series, and by the progressive origin of the mountain-ranges. Then, in the edition of 1874 (and also that of 1880) I bring in (p. 525) the paragraph which Mr. Wallace cites in his Chapter IX. (p. 196)—not as the expression of an "opinion," but as the summing up after a demonstration.

The view that the continents have always been continents, which I have held for forty years, is written so plainly in the geology of North America that I am sure it would never have been set down among speculations, even by the most exacting of British geologists, had attention been fairly given to American facts. If the truth is not taught by British rocks, it is because these represent only a narrow margin of a continent, and hence could not be expected to illustrate general continental development, hardly more than an animal's leg, however profoundly studied, the embryological laws of the species.

JAMES D. DANA

New Haven, Connecticut, February 8

The Aurora of January 31; Position of Auroral Rays

THE bright loop shown in G. F. Seabroke's drawings of the aurora on January 31 at 6.30 and 6.35 p.m., as seen at Rugby, remind me of a striking feature seen here. If it was the same, a comparison of the observations will give some idea of the height of the phenomenon. As seen here at about 6.24½ this feature was the most conspicuous part of the aurora; it was a somewhat pear shaped bright patch, with a region along the middle of it not quite so bright. Its edge was 10° above the moon, at Venus, Jupiter, β and η Pegasi; its pointed end being low down, and a good deal further to the right. At 6.26½ Venus was in the midst of its left end, and Jupiter quite outside. The moon was 5° below the lower edge. The dusky region gradually darkened, and finally opened through the right end of the patch, which became united by a rather serpentine bright band to a somewhat similar, but partly red, bright patch rising up in the east-north-east. This bright band formed the southern border of the aurora. At 6.31½ the position of the central line of this band, including the western bright patch which now formed a loop in it open to the north, was about as follows:—At or near the moon, one-third of the way from ι Ceti to Venus, ζ Cygni (the junction of the patch with the new band), α Pegasi I think, β Trianguli, α Tauri, and below Procyon.

The motion of these features, as well as of all the large masses of the aurora throughout the evening, was approximately from east to west (magnetic), so far as I could observe. The four or more arches seen at Rugby by G. M. Seabroke at 6.35 were not seen by me.

The spectrum of this aurora was very similar to those of February 4, 1874, and October 4, 1874, as given in Capron's "Auroræ," Plate V.; the band marked 4 of the former being sometimes present and sometimes absent. I also saw traces of the red line at times.

I am surprised that Prof. S. P. Thompson (NATURE, vol. xxiii. p. 289) is not aware that it is a thoroughly ascertained fact that the rays of auroras lie in the direction of the magnetic dip. I may add that the flashes or pulsations also generally appear to move away from the earth in the direction of the magnetic dip.

Sunderland, February 24 T. W. BACKHOUSE

Auroric Light

AS Mr. W. H. Preece records the magnetic storms, if not too much trouble would he record what took place on the night of January 16?—as at midnight there was all the appearance of a grand display, but as the windows were all frost-masked, and my only place of observation was exposed to a cutting wind that would have "shaved a cast-iron policeman," to quote *Punch*, I could not observe what took place. I should also like to know why the grand displays this winter are of white lights. Those I saw in previous years—the best being while stationed in West Galway between 1867 to 1872—were principally red lights, some of them being most brilliant between midnight and morning, while all of them this year have been best early in the night, all lights usually disappearing before or a little after eleven. I am used to white lights in the summer months, but I never before saw them so prominent in the winter months—main lights, cross lights, and glows being white; while usually, each respectively have different colours. I have not seen an aurora that changes so much in character as the last, except that of September, 1867 or 1868 (I think, but I have not my notes to give the exact year). That of 1867 or 1868 was a grand display, rising in a red mass to the zenith, and then shooting out pencils of red, green, white, purple, and orange lights.

G. H. KINAHAN

Ovoca, February 20

The Recent Severe Weather

GRANTING (1) that solar periodicity produces a corresponding periodicity in any of the elements which make the climate of the earth as a whole what it is, and (2) that the expression for that periodical change contains only the two first terms of the general expression, *i.e.* that there are no secondary . . periods, both large admissions in the present state of our knowledge, it does not appear how a simple fluctuation of solar temperature, recurring, we will say, every eleven years, could produce several periodic fluctuations of terrestrial temperature, identical in duration but not simultaneous, some one or more being therefore partially or completely opposed in phase to some one or more of the remainder, and to the causal fluctuation

Further, we know that solar conditions are not as simple as those above assumed, and that the sun spot period is subject to large and seemingly capricious variation amounting to something like $\pm$ 3 years at least. If then, as some able physicists believe, solar atmospheric changes are reflected in marked variations in terrestrial climate, we shall find these latter to be common to the whole earth, and to be represented by a function of the same form. The mere citation of local (for in this view even the climate of Europe is merely local) phenomena which have occurred at intervals approximately equal *individually* to the *average* length of a sun-spot period, proves nothing in favour of the view supported by your correspondent "H W. C," in NATURE, vol xxiii pp 329, 363; and an analysis of the dates given in his first communication, which would make the occurrence of great frosts simultaneous, sometimes with sun spot maxima, at other times with sun-spot minima, seems calculated to weaken his case in a material degree, on the supposition of an *uniform* eleven-year cycle

Arranging the dates given by him in parallel column with the eleventh years of the present century, we get

Dates of severe frost	1800 +
1. 1801—2	0
2 1810—11	11
3 1813—14	—
4 1819—20	22
5. 1837—38	33
6 1840—41	44
7. 1856—57	55
8. 1860—61	66
9. 1870—71	77
10 1880—81	88

2 and 7 are placed as above, as those positions seem to favour the cyclic theory more than their original ones did. A *complete* list of great frosts collated with *actual* sun-spot variations is however most desirable, and would be specially valuable if representative of terrestrial climate in the cosmical sense. I trust that H. W. C will favour us with such a table.

London, February 19 M. R. I A.

Migration of the Wagtail

I FEAR I may be attempting to trespass too frequently on the columns of NATURE recently, but the paper in vol xxiii. p 387 on the subject of wagtails taking a passage on the backs of cranes in a long flight, resembles so much a somewhat similar story told and believed in by the Indians in several parts of North America, that I venture to send you an account of it

All the Indians (Maskegon Crees) round the south-western part of Hudson's Bay, assert that a small bird of the Fringillidæ tribe takes a passage northward in the spring on the back of the Canada goose (*A Canadensis*), which reaches the shores of Hudson's Bay about the last week of April.

They say that they have often seen little birds fly away from geese when the latter have been shot or shot at.

An intelligent, truthful, and educated Indian named George Rivers, who was very frequently my shooting companion for some years, assured me that he had witnessed this, and I believe I once saw it occur.

It is only the Canada goose that these little migrants use as an aërial conveyance, and certainly they both arrive at the same date, which is a week or two earlier than the other kinds of geese (*A. hyperboreus* and *albifrons*) make their appearance.

I knew the little bird well and have preserved specimens of it, but it is so long ago that I have forgotten the name.

The Indians on the shores of Athabasca and Great Slave Lakes—both great resorts of wild geese—tell a similar story. If a fabrication, I do not see why it should be invented about the Canada goose only, and not about other species which are equally numerous

It may perhaps be necessary to explain that all the Coast Indians of Hudson's Bay devote a month or more every spring to wild fowl (chiefly geese) shooting, the game killed forming their entire food for the time.

As soon as the geese begin to arrive, the Indian constructs a concealment of willows and grass, usually near a pool of open water, at the edge of which he sets up decoys. When geese are seen approaching (usually flying at a great height) the Indian imitates their call, and the geese on seeing the decoys circle round, gradually coming lower down until within shot, when they are fired at It is from these high-flying geese that the small birds are seen to come

If the geese are flying low it is a pretty sure indication that they have already rested on the ground somewhere near, after their long flight, when of course then tiny passengers would have alighted. JOHN RAE

Royal Institution, February 26

Phosphorescence of the Sea

YOU will perhaps permit me to record the occurrence of a phenomenon very rarely witnessed on this coast—I mean the general and quasi-spontaneous luminosity of the sea

It is of course common enough to observe sparkles of light more or less abundant when sea-water is briskly disturbed by contact with an oar or the bow of an advancing vessel, but it has only once before been my fortune, and that was twenty years ago, to witness the crest of each wavelet illuminated by the pale silvery light proceeding from countless phosphorescent organisms present in the water.

The night, being cloudy, favoured observation, but there was considerable haze The wind was south east or thereabouts, the temperature of the air being 52° F, that of the sea close by the shore 47°·5 F

The phenomenon was visible on the night of Thursday, February 17 only. The following night was equally favourable for observation, and the temperatures were the same within a degree, but the cause or causes no longer operated. On casting into the sea a shower of pebbles, which the night before produced brilliant flashes of light, or larger stones, which then developed concentric luminous wavelets, only a doubtful effect was observed. The organisms had, it seemed, already expended their force—probably had actually died—and I thought I perceived an unusual frothiness in the water

Is it not uncommon for this to occur so early in the year? It is in summer, when the temperature of the sea is high, that we expect to see the water "fiery." Was the phenomenon observed on other parts of the coast? THOS B GROVES

Weymouth, February 21

Minerva Ornaments

I HAVE twice had an opportunity of being in London during the time Dr Schliemann's Trojan antiquities were exhibited at South Kensington, and the examination of them gave me very much pleasure. My last visit took place at the time Mr. Claypole's first letter and Prof Sayce's reply appeared in NATURE, and I gave the "Minerva ornaments" particular attention. My interest in the subject has been revived by seeing another letter from Mr. Claypole in a recent number, and having refreshed my memory from notes taken during my visits, perhaps you would kindly afford me space for a few remarks

Some of the "Minerva ornaments" appeared to me somewhat similar to Irish objects in my possession, but mine are more symmetrical, less flattish, and on the whole more suitable, I should say, for net-sinkers than the others, yet I never thought of ticketing them as such. I think that both sets of objects have had too much labour expended on them to favour the idea that they were used for such a common object as net-sinking. The Irish objects, which I should say are of stone, are identical in form with a class of glass ornaments known as double glass beads, found in most collections of Irish antiquities, which are certainly not net-sinkers. "Net-sinker" is a very common name in Ireland for almost any stone with a hole in it, and, without intending the slightest disrespect to Mr. Claypole, I believe the term is one of a set, of which "sling stone" is another, applied in doubtful cases to cover our ignorance As regards the use of the objects discovered by Dr. Schliemann, there may

be good grounds for believing that they were idols, but had I been left without help to interpret for myself I should not have guessed them to be net sinkers, but rather children's playthings—the ancient representatives of modern dolls. To show how little pains are sometimes taken in the preparation of net-sinkers, I may mention that a few months ago, while walking along the banks of the River Bann, I saw a fisherman cutting the tough sward into pieces about two inches by three or four, which, in answer to my inquiry, he informed me were intended for net-sinkers. I asked him why he did not use stone or lead, and he replied that turf sinkers were much superior, as in using them the nets never became entangled in the bottom of the river. I wonder if this custom is a recent invention or a survival from earlier times.

I was struck by the close resemblance which several other objects in the Schliemann collection bore to Irish antiquities. I have noted several tool stones with the usual hollowed marks on the sides, especially those bearing the double numbers 26 and 1578, 26 and 1478, 26 and 1522, 45 and 1499, and also a stone celt or hatchet with marks on the sides like those on the tool stones, and hammered at the edge, numbered 13 and 1505, all of which I could match from my own collection. Several whorls are marked in my notes as being similar to others found in Ireland, and an object bearing the numbers 6 and 1636 as being almost identical with double stone beads in my collection. I have also a large series of rubbing or polishing stones similar to others in Dr. Schliemann's collection. Hammer stones numbered 6 and 7268, 26 and 1529, 26 and 1566, 13 and 1570 are perfect duplicates of some of those found by myself, with flint and bone implements, &c., at Portstewart and Ballintoy. The ornamentation on a few of the stone and glass whorls and beads in my collection have a sort of resemblance to that on some of the terra-cotta whorls exhibited by Dr. Schliemann.

Cullybackey, Belfast, February 10 W. J. KNOWLES

Selenium

THE use of selenium for the automatic registry of star transits, proposed by me in a letter which you were good enough to publish in NATURE, vol. xxiii. p. 218, leads to the idea of applying it in a somewhat similar way for photometric purposes, in order to improve the existing scale of star magnitudes, and to watch any variations therein. W. M. C.

Bombay, February 5

A CHAPTER IN THE HISTORY OF THE CONIFERÆ

THE Sequoias form the third genus of the Taxodieæ in the "Genera Plantarum." The only existing species are the Wellingtonia and the Red-wood of California, both of which are confined to the south-west coast regions of the United States. Their nearest living allies are Taxodium and Glyptostrobus, but these were as completely differentiated in the Eocene as at present, and they all appear, like the Ginkgo, to be survivals from more ancient floras; Sequoia especially had formerly a far wider range than it has at the present day.

The Sequoias are monœcious, and have obtusely ovate ligneous solitary and terminal cones one to two inches in length, which are persistent and gaping after shedding the seed. The scales are spirally disposed, sixteen to twenty in number, wedge-shaped, with an orbicular or transversely oblong nail-like head, depressed, wrinkled, and mucronate in the centre, sharing thus to some extent the ornamentation which seems a characteristic of the Taxodieæ. The foliage is distichous and yew-like in *Sequoia sempervirens*, and spiral and imbricated in *S. gigantea*, but both occasionally foliate in the opposite way. The former, or red-wood, occupies the Coast Range, a sandy rock rising to 2000 feet, of supposed Cretaceous age, and forms dense forests twenty to thirty miles in width, from a little south of Santa Cruz to the southern borders of Oregon, following the coast line for some 350 to 500 miles, its distribution depending, according to Prof. Bolander, upon the sandstone and oceanic fogs. The *S. gigantea* extends at intervals along the western slope of the Sierra Nevada for nearly 200 miles, and at elevations of 5000 to 8000 feet. "Towards the north the trees occur as very small, isolated, remote groves of a few hundreds each, most of them old and interspersed amongst gigantic pines, spruces, and firs, which appear as if encroaching upon them; such are the groves visited by tourists (Calaveras, Mariposa, &c.). To the south, on the contrary, the Big-trees form a colossal forest forty miles long and three to ten broad, whose continuity is broken only by the deep sheer-walled cañons that intersect the mountains; here they displace all other trees, and are described as rearing to the sky their massive crowns; whilst seen from a distance the forest presents the appearance of green waves of vegetation, gracefully following the complicated topography of the ridges and river-basins which it clothes."[1] The leaves are scale-formed, rounded dorsally, concave on the inner face and closely inlaid, regularly imbricated on the branchlets, longer and looser on the branches. In young trees they are much larger and freer, with long and awl-shaped leaves at an acute angle to the stem. No trees under cultivation in this country seem yet to have completely assumed the small imbricated foliage characteristic of the giant trees of California.

Although the types of foliage in the two existing species appear to be perfectly distinct, they are not really entirely so; for *S. sempervirens* preserves the spiral scale-like leaves for a short distance at the base of each branchlet, and *S. gigantea* sometimes assumes the distichous arrangement. Besides, the foliage of the former is not in two rows as it is in Taxodium, being spirally arranged round the stem; but the leaflets, where they are flat and comparatively expanded, have a strong tendency to crowd into two marginal rows, so that every surface becomes exposed to light and moisture. The leaflets take a half twist near their base, and then diverge upward or downwards towards the sides of the branchlet, an additional row frequently lying centrally along the branch.

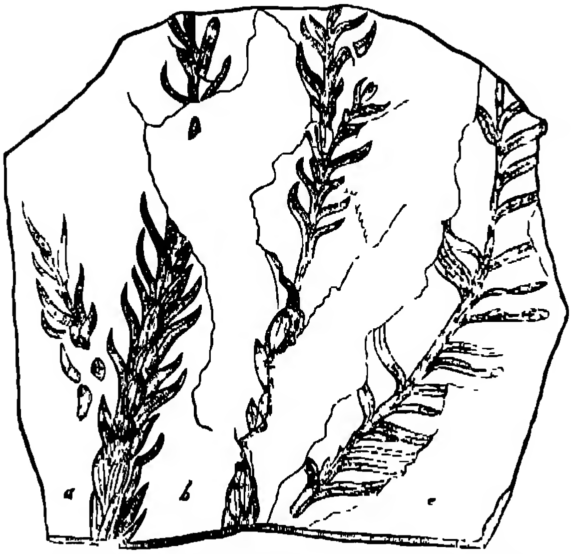
The earliest-known Sequoias are Cretaceous, and were described by Carruthers, one as *S. Woodwardii* from Blackdown, and others as *S. Gardneri* and *S. ovalis* from the Folkestone Gault. The foliage from the latter has falcate leaves like Araucaria, and it is only inferred that it and the cones belonged to the same trees. It is not impossible that the cones may have been brought down from some high ground, and the foliage been shed by trees nearer the sea-level. Although Sequoia itself cannot be traced farther back than the Cretaceous, Schimper speculates on its probable derivation from some much older Araucarian form, and believes its position to be between the Cupressineæ and the Abietineæ.

Saporta regards the Chalk period as the age of Sequoias, and our principal knowledge of them is derived from Heer's "Flora fossilis arctica," where a large number are figured. Saporta speaks of Pattorfik as a Sequoia wood carpeted with ferns, and Ekkorfat as a forest composed of cycads, sequoias, and firs. *S. Reichenbachii* is the chief form, and occurs in the Cretaceous of Kome, Spitzbergen, and doubtfully at Atane. The foliage resembles the larger foliage of *S. gigantea*, being spiral, awl-shaped, set at an acute angle to the stem, and with the points overlapping. It differs in being less regularly spiral, and often combines an approach to the more distichous *S. sempervirens* type, being called in such cases, *S. Smittiana*. In several of the figured specimens from the Komeschichten the branchlets of the two forms are almost united, and a very slight degree more care in collecting would, it seems, have placed the reality of the union beyond the possibility of doubt. One instance is reproduced from plate xx., and a fragment from the same plate determined as *S. Reichenbachii*, to show that even apart from the frequent association of the two species on the same slabs, their distinctness cannot be maintained if the

[1] Lecture before Royal Institution, April 12, 1878, by Sir J. Hooker.

plates are faithfully drawn. The separation of another species, *S. rigida* from *S. Smithiana*, seems even less warranted; but *S. ambigua* has somewhat smaller foliage and cones, and *S. gracilis* still smaller foliage, approaching *S Couttsiæ*, yet compared, for no obvious reason, with *S. Gardneri*

Spitzbergen has no Cretaceous species peculiar to it, but the Upper Cretaceous of Atanekerdluk possesses, besides two of the Komeschichten species, *S fastigiata*, Sternb., and *S. subulata*, Heer. These two bear the



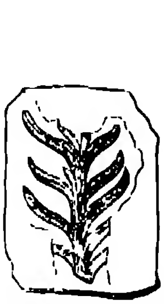
a b, *S Reichenbachii*, *c*, *S Smithiana*, Fig 7, pl xx vol iii "Flora foss Arctica"

same relationship to each other that we have seen between *S Reichenbachii* and *S Smithiana*, only they are both considerably smaller, and were, as in the other case, doubtless the same tree

S Reichenbachii is said to be met with in other Cretaceous deposits in Bohemia, Saxony, Moravia, Belgium, &c, and *S. fastigiata* over the same, but a more restricted area, their wide distribution being held by Saporta to evidence a former universal equality in temperature

It is of course useless, without further material, to seek

S. rigida, Fig 11a, pl xxii.



S Reichenbachii, Fig 8, pl xx

to unite the whole of the above species, since they have been described as distinct by Heer, but it seems perfectly certain that had collecting been systematically carried on, a small proportion only of the specific distinctions could have been maintained. The excessive subdivision is to be regretted, since it has given undue prominence to the Arctic Sequoias of this age as a group, and will otherwise lead to inconvenience Their chief and most interesting characteristics have been overlooked by Heer These are first the union in one plant of the now almost completely differentiated *S. sempervirens* and *S gigantea* types, and second, that the foliage, which then approached to the distichous *S. sempervirens* form, was produced, if the plates are correctly drawn, by the shortening almost to abortion of the upper and under leaves, and not to their being narrowed at the base and twisted, as at present, towards the sides of the branchlets.

The Arctic Tertiaries have yielded no foliage of the spiral, needle-leaved *S gigantea* type, except that which has been referred to *S Couttsiæ* The large Araucaria-like foliage of *S. Sternbergi* does not seem at that time to have existed much farther north than Iceland, while the *S sempervirens* type seems to have been abundant. *Sequoia Langsdorfii* is in fact the prevailing fossil in Greenland, scarcely any stone with leaf impressions being without some remains of it The branchlets are generally simple and single, rarely forking, and seem thus to have had a short season of growth and been quickly shed, an adaptation probably to the long Arctic winter. Flowers, fruits, and seeds have been collected It is hardly less abundant at Spitzbergen, Mackenzie River, and other localities near the Arctic circle and in Iceland The cones are said to be somewhat larger, and with more scales, and the leaves less pointed than in the existing species The more decidedly imbricated character of the fruit-bearing branchlets implies a closer affinity with the Cretaceous forms Heer makes six duly-named varieties out of the Spitzbergen species, being probably unaware of the extent to which foliage on the same tree may vary at the present day *S brevifolia*, again, is at best a variety, and *S disticha* has leaves in opposite pairs, and while unlike in this respect, has nothing besides to support its reference to Sequoia *S Langsdorfii* next appears in the Miocene Baltic and in the Aquitanian and Mayencian stages in Switzerland, Germany, Austria, and France, but does not seem to appear in any Upper Miocene beds except as far south as Italy, where it occurs in several localities This distribution is important, as well as the fact that branchlets from beds of Central Europe are more compound than those from the far north Another Spitzbergen species, extremely abundant where first found, is *S Nordenskioldi*, said to be distinguishable by smaller and softer foliage, narrower leaflets scarcely tapering at the base and at more acute angles to the stem, the last being the chief distinctive character None seem to have been met with in the 1872 expedition, only *S Langsdorfii* being illustrated in the fourth volume of the "Flora fossilis arctica"

Another species belonging to the same group, described by Saporta as *S Tournalii*, is found in the Miocenes of Manosque, Armissan, and Kumi. It is principally characterised by the clustered, rarely solitary cones, and while the foliage resembles generally that of the existing species, the branchlets bearing fruit were much more imbricated, and in this respect resembled those of *S. Langsdorfii* of the Arctic floras

Most of these types have also been met with in America —where Lesquereux, following Heer, has over-subdivided the fragments into species

The *S gigantea* type had by far the more restricted distribution of the two in the Tertiaries Much of this form of foliage from the Lower and Middle Eocenes of England and France has been referred to Araucaria; but elsewhere, in the Oligocenes especially, almost the whole of it is referred to a single species of Sequoia, *S Sternbergi* It agrees with that of young plants of *S. gigantea*, the leaflets being less falcate, longer, and at a more acute angle to the stem than in the nearest existing Araucaria. On the other hand, however, no nearer approach to the ordinary adult foliage of *S gigantea* is ever associated with them The characteristic cones of Sequoia, which are small and numerous, and very persistent on the branches after the seed is shed, remain attached in several fossil species, as *S Couttsiæ*, wherever

they are met with, but are rarely associated with the foliage figured as *S. Sternbergi*, none having been found at such important localities as Sotzka, Haring, Monte Promina, and Bilin, where foliage abounds. This absence of cones is very strong negative evidence against their foliage in the above localities at least being Sequoia, and in favour of their being Araucaria. The cones of Araucaria are few and large, shaken to pieces by the wind almost as as soon as ripe, and when carried by water the flotation of the winged seeds and of the foliage would differ enough to lead to their being separately imbedded. The foliage was described for years as *Araucarites*, and a well-defined immature cone of Araucaria was found in the deposit at Haring and figured by Sternberg[1] and by Goeppert[2] as *Araucarites Goepperti*, and afterwards considered by Unger and Ettingshausen[3] to belong to *A. Sternbergi*. Another small Araucaria-like cone is figured by Massalongo from Chiavon,[4] which was found associated with foliage identical with that from Bournemouth. Similar foliage, but still nearer to Araucaria, is found at many places in France, and in England at Sheppey, Bournemouth, Bracklesham, the Isle of Wight, &c., but also always without any Sequoia cones, although I have found an Araucaria cone at Sheppey.

Against all this evidence we have to set the fact that a branch with compressed cones attached has been found in the Upper Miocene near Turin, and that Sequoia cones are found in the same strata with somewhat similar foliage in Iceland. In both these instances however the foliage differs materially from the typical *S. Sternbergi* of Sotzka. If we consider that foliage of existing species of Araucaria, Sequoia, Cryptomeria, and Arthrotaxis can with difficulty be distinguished, and that species which have died out may have approached ~~each other~~ still more closely, the evidence upon which Heer has changed the determination of all the Austrian and German specimens must appear insufficient. The possibly accidental similarity, not identity, of foliage occurring in deposits far apart and of widely different age, does not, I hold, outweigh the other facts I have advanced.

This type of foliage, whether it belong to one or many genera, has not been found of Tertiary age north of Iceland, nor in the newer Miocenes of Central Europe, if we set aside two more than doubtful fragments from Oeningen. It abounds however in England, France, Germany, and Austria in Eocenes and Oligocenes, and recurs, as an Upper Miocene form, in Italy only.

The British Eocenes have been credited with several Sequoias, as *S. Sternbergi* and *S. Bowerbankii* from Sheppey, *S. Langsdorfii* from Alum Bay and Bournemouth, *S. du Noyeri* from Antrim, &c., &c. There is, I believe, no good evidence yet of the presence of any Sequoia except *S. Couttsiæ*, confined to Bovey, Hempstead, and perhaps Bournemouth, in any Tertiary rock of Great Britain. This question however cannot here be profitably discussed. *S. Couttsiæ* was originally described by Heer from Bovey Tracey, where it literally abounded. The foliage resembles that of *S. gigantea*, though smaller and more delicate, and must have been very graceful, but Heer's restoration of it, since copied into other works, is very stiff and unnatural. The foliage in the "Flora fossilis arctica" is much coarser, and should not have been referred to the same species. Saporta describes a beautiful variety "*Polymorpha*" from Armissan, in which the ultimate branchlets take on the *sempervirens* character. *S. Couttsiæ* seems to have been capable of supporting considerably greater heat than any of the other species, if we may judge from the associated plants.

The leading facts known to us respecting the past history of the Sequoias may be summed up thus. They are not known to be older than the Cretaceous, when they were principally a northern form. The differentiation of the existing types has progressed from that period to the present, being slight in the Cretaceous (*e.g. S. Reichenbachii*), more pronounced in the Eocene (*e.g. S. Couttsiæ v. polymorpha*), yet more so in the Oligocene and Miocene (*S. Langsdorfii*), and most so at the present day, though even now there is a tendency to approach each other. The number of fossil species should be considerably reduced, and much of the supposed Sequoia foliage transferred to other genera. The genus is known to have ranged as far south as Central Europe during the Cretaceous, seems to have retreated north during the Lower and Lower Middle Eocenes, re-occupied its former habitats in the Upper Middle Eocene and Oligocene, first through *S. Couttsiæ*, and then through *S. Langsdorfii*, and ranged into Italy during the Upper Miocene. It was well-nigh exterminated during the Glacial epoch, and has been strangely preserved in two isolated spots, perhaps beyond its original range, where the moderating influence of the Pacific enabled it to survive on, or occupy at a remote period lofty mountain spurs between the sites of ancient glaciers. Fixed on exceptionably favourable stations with congenial soil, the existing species may have slowly adapted themselves to a temperature far more genial than that supported by their polar ancestors, and, in adapting themselves to an always increasing mildness, have acquired that stupendous habit of growth which makes them the giants of vegetation.[1]

The moral to be drawn from the history of the Sequoias is that we should not place implicit credence in the minimum temperature of the so-called Miocene Greenland, Spitzbergen, Vancouver's Isle, Sitka, and Arctic America and Asia, as settled by Heer. Such bald argument, as for instance that because Sequoia now requires such and such a temperature, therefore former but different species must have required the same, is entitled to but little deference; yet Heer's facts and opinions are quoted as axioms by a wide range of workers. When examined they are seen to be disputable, whether taken as physiological, geological, palæontological, or any other data. Provisionally they were of use, but the questions depending on the accuracy of the data are so important and the evidence so intricate that they should not be deemed settled until some greater amount of care has been bestowed on them.

J. STARKIE GARDNER

GEOMETRICAL TEACHING[2]

WE are glad to see that the Association for the Improvement of Geometrical Teaching has been by no means idle, though no report has been issued since January, 1878, but that there has been a good deal of silent work going on in the way of sub-committee discussions upon the several syllabuses of solid geometry, of higher plane geometry, and of geometrical conics. All who know the president will heartily sympathise with him in his bereavement, and will understand how unfitted he must have been for any other work than that which his position at Harrow imperatively required of him. He has now thrown himself with much energy into the cause, and proof of his interest in the labours of the Association is manifest throughout the interesting address which is printed on pp. 12-17 of this Report. It is well known that he has long advocated an extension of the scope of the Association, and in this address he takes the opportunity of putting his views well forward.

"It was doubtless well at the outset of our work to concentrate our attention and confine our efforts to the definite field, in which perhaps the need for improvement

[1] "Verst.," vol. ii. p. 204, Pl. 39, Fig. 4.
[2] "Monogr. foss. Conif.," 1850, Haarlem *Trans.*, p. 237, Pl. 44, Fig. 2.
[3] "Flora von Häring," p. 36.
[4] "Specim. Photogr.," pl. xxi.

[1] If we can really trace back the history of *S. gigantea* to fossil forms, it becomes curious to notice that it is only now approaching *S. Couttsiæ*, the type which there is reason to believe formerly supported the highest temperature of any Tertiary Sequoia.
[2] Association for the Improvement of Geometrical Teaching. Seventh General Report, January, 1881.

was most pressing, that of the teaching of geometry. But it can hardly be denied, I think, that there are other branches of mathematics whose teaching might also be greatly improved by an association of teachers, conferring together as to the defects of existing books or methods, and intrusting to sub-committees the task of suggesting means of remedying such acknowledged defects. If this be granted it appears to me that it is our next duty to bring the strength of our existing organisation to bear on other branches of mathematics besides pure geometry To do this would, I believe, assist rather than injure the work which we have still to do for geometry.

"I cannot doubt but that we have to some extent suffered from the restriction of the field within which we have hitherto worked Elementary geometry is essentially a *school* subject, that is, one in which a student of mathematics ought to be fairly proficient before he enters on his university course, and which therefore is not a subject of *real teaching* in our universities or higher colleges at all. To this, and not to any ingrained spirit of opposition to improvement, which in the face of the changes going on in our universities it seems to me it would be absurd to charge upon any body of active workers therein, I am inclined to attribute the small amount of interest and attention which we have hitherto been able to obtain for our work, and our failure as yet to procure any recognition of our syllabus in any university of the United Kingdom Where a subject is not taught, but is only a subject, and rather a subordinate subject, of examination, there can hardly be any very lively and active interest in the improvement of its teaching. It is reasonable to expect, therefore, that, by extending the scope of our work to other subjects, of which only the elements can in general be taught in schools, and which will afterwards be more fully studied at the universities, we shall enlist the sympathies of a wider circle of mathematical teachers, extend the list of our members, and connect ourselves more intimately with the living mathematical teaching of our universities, and then we shall, I believe, greatly promote the recognition of the work which we have already done. Algebra and trigonometry are perhaps less in need of our attention than other subjects, though even as regards these I believe valuable suggestions as to improved methods and range of teaching would arise in the discussion of a committee specially interested in them But it is only necessary to mention the subjects of analytical geometry, higher geometry, higher algebra, elementary kinematics and dynamics (or mechanics), to bring before the minds of those whom I am addressing a number of questions as to their teaching, from the discussion of which great advantages might arise Further, I think no one can have followed the more recent expositions of mathematical physics, more especially in the 'Matter and Motion' of Maxwell, and the 'Elements of Dynamic' (alas, only a fragment) of Clifford—to mention only the names of two of the most penetrative geniuses and profound thinkers of our age, whom we have loved and admired while living, and whose premature deaths we, in common with the whole world of mathematical and physical science, deplore as an irreparable loss—without feeling convinced that the time is not far distant when the notion of a *vector* or *step*, as Clifford happily names it, and the simpler consequences of that notion forming a *vector* or *step*-geometry (the basis of the calculus of quaternions), must be made a part of the elementary studies of every student of mathematics, more especially for the purposes of mathematical physics, but perhaps not less for its application to pure geometry. And if this be so I cannot help thinking that our Association, extended as I have suggested, might be the means of bringing together the right men to organise the method and bring it into a suitable stage for elementary instruction . . I refer to the improvement of the teaching of arithmetic. I suppose there are none of us here who have had any experience in the teaching of arithmetic, who have not often wished that they could make a *tabula rasa* of their pupils' minds, as regards this subject, so fatally destructive of all appeals to reason have early unintelligent teaching and bad traditional methods shown themselves to be In an effort to reform in many points the teaching of arithmetic, we might naturally expect to associate with us the best teachers in preparatory and even in primary schools; and perhaps also members of that very important body of men, the Government Inspectors of Schools, and thus our organisation might become the means of linking together all grades of mathematical teachers, from the humblest to the highest, in an association which could not fail, if heartily supported, to become a powerful influence for good on the whole education of the country"

As the President's proposal took many of the members present by surprise, it was ultimately resolved, as we read, that a special meeting of the Association should be held about Easter next, to consider the desirability or the contrary of thus extending the scope of the Association

In connection with this matter we have also received a letter addressed to non-members to ascertain, if such an extension of the aims of the Association were adopted, whether they would allow themselves to be proposed as members of the new Association A draft of rules accompanies the Report, from which we extract the following proposed rules —"That the Association be called 'The Association for the Improvement of Mathematical Teaching', that its object shall be to effect improvements in the teaching of the various branches of elementary mathematics and mathematical physics by such means as may appear most suitable in each particular case This object to be carried out by the reading of papers or raising discussions at meetings of the Association, by the appointment of committees to report on existing defects in the usual methods, order, range, &c, in teaching special subjects, and the expediency of drawing up syllabuses or text-books of such subjects, by the employment of suitable means for bringing the work done by the Association before the universities and other educational or examining bodies, and using its influence to obtain recognition of such work from those bodies"

Another action on the part of the meeting was the passing a resolution "that a sub-committee be appointed to draw up proofs of the propositions of the syllabus of plane geometry" It was shown that many teachers had adopted the syllabus, and that it was meeting with a growing acceptance was evidenced by the steadily improving annual sale, 2033 copies having been already sold

ILLUSTRATIONS OF NEW OR RARE ANIMALS IN THE ZOOLOGICAL SOCIETY'S LIVING COLLECTION[1]

II.

NORTH-EASTERN ASIA has of late years disclosed to its explorers a number of very curious novelties in the class of Mammals Amongst them are several species of great interest, examples of which have reached the Gardens of the Zoological Society alive.

4. The Tcheli Monkey (*Macacus Tcheliensis*) was so named by the distinguished zoologist, M Alphonse Milne-Edwards of Paris, from the Chinese province of Tcheli (or Petcheli), in which it is found The existence of a monkey in a latitude so far north—on nearly the same isothermal line as the city of Paris is a very remarkable fact, and quite new to zoological distribution

The occurrence of this monkey in the mountains of the north-eastern district of the province of Petcheli seems to have been first ascertained by M. Fontanier, who was for some years French Consul at Pekin, and who transmitted

[1] Continued from p 38.

many valuable specimens to the Museum of the Jardin des Plantes at Paris. Amongst these was an example of the present animal—a female, not quite adult—which was described and figured by M Alphonse Milne-Edwards in his "Études pour servir a l'Histoire Naturelle des Mammifères" (Paris, 1868-1874) The celebrated naturalist, Père David, also seems to have met with this monkey in the same district, as he includes it in several lists of the Mammals of Northern China which he has recently published.

For their pair of this scarce monkey now living in the Regent's Park, the Zoological Society are indebted to the kind exertions of one of their Corresponding Members, Dr. S. W. Bushell of H B.M. Legation at Pekin. Dr Bushell obtained these animals in 1880 from the Yung-ling, or Eastern Mausoleum, of the reigning Manchu dynasty, situated about 70 le from Pekin to the north of 40° N L.

The Tcheli monkey belongs to the same section of the group as the well-known Rhesus monkey (*Macacus rhesus*), but has a shorter tail, and is generally of a more rufous colour. It is also readily distinguishable by its dense coat of short thick fur, adapting it to endure the bitter winter climate of its native hills, where the thermometer often descends 10° below zero. Like most of its congeners it is rock-loving in its habits.

5. The Water-deer (*Hydropotes inermis*) is another Chinese animal which has only lately become known in Europe.

Until of late years it was supposed that the annual production of deciduous bony processes (antlers) from the frontal bones was an invariable characteristic of the males of the deer-tribe (Cervidæ) In some cases these antlers might attain enormous dimensions, as in the Wapiti (*Cervus Canadensis*) and the Elk (*Alces machlis*); in others they might consist only of diminutive points, as in the Pudu-deer of Chili (*Pudua humilis*). But they were always present to a greater or less extent. The discovery of this little animal served to confirm, however,

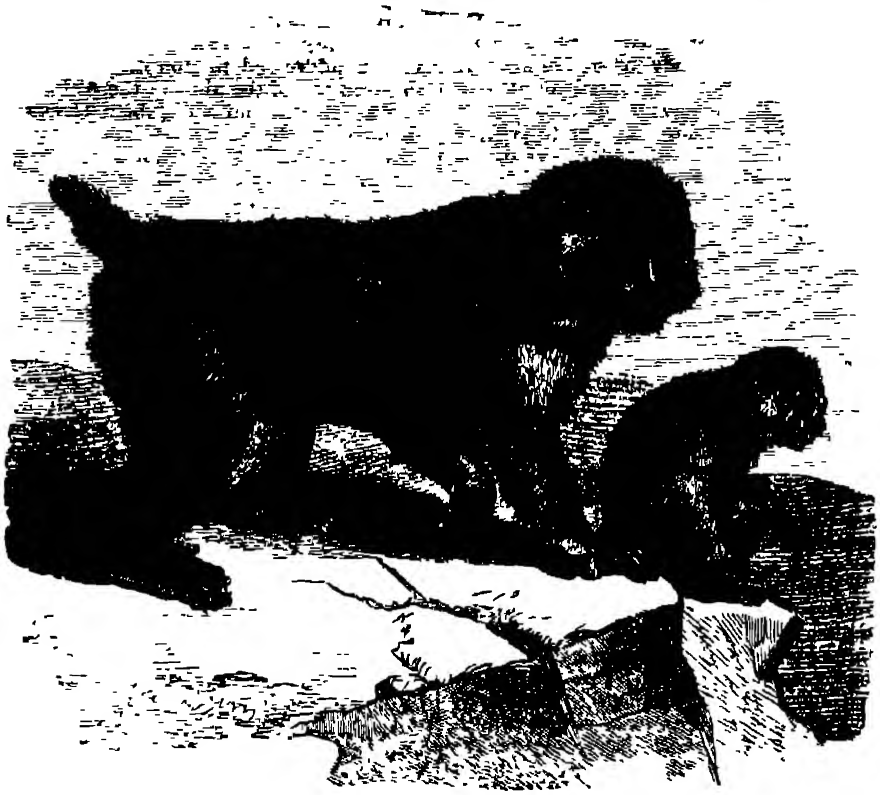


FIG 4.—The Tcheli Monkey

the truth of the axiom, that in Nature at least there is no law without an exception. Here we have a deer complete in everything except its antlers, usually the *most* characteristic feature in the males of these animals. In place of antlers the buck Water-deer is provided with other organs of defence in the shape of two long exserted canine teeth, which grow to a considerable size in the adult, and give him ample means of exercising his pugnacious powers.

For our first knowledge of the existence of this singular deer we are indebted to the exertions of the late Robert Swinhoe, who, during his residence in various parts of the Chinese Empire, added so largely to our knowledge of every part of its fauna. Mr. Swinhoe obtained his first specimens of the *Hydropotes* in the market of Shanghai in the winter of 1879, and described it at one of the meetings of the Zoological Society in the following year.

"In the large riverine islands of the Yangtsze above Chinkiang," Mr Swinhoe tells us, "these animals occur in large numbers, living among the tall rushes that are there grown for thatching and other purposes. The rushes are cut down in the spring; and the deer then swim away to the main shore and retire to the cover of the hills.

"In autumn, after the floods, when the rushes are again grown, they return with their young and stay the winter through They are said to feed on the rush-sprouts and coarse grasses, and they doubtless often finish off with a dessert from the sweet-potatoes, cabbages, &c, which the villagers cultivate on the islands during winter

"They cannot however do much damage to the latter, or they would not be suffered to exist in such numbers as they do; for the islands have their villages and a pretty numerous agricultural population. Fortunately for the

deer, the Chinese have an extraordinary dislike for their flesh. They are therefore only killed for the European markets, and sold at a low price. The venison is coarse and without much taste, but is considered tolerable for want of better, it is the only venison procurable in Shanghai. The animal itself gives sport to the gunner; and numbers are slaughtered every winter by the European followers of Nimrod in the name of *sport*. Their numbers however do not appear to get much thinned."

Another most remarkable characteristic of these antlerless deer is their extraordinary fecundity. Mr Swinhoe states that according to the testimony of the natives the mothers have four or five young at a birth, and that this is corroborated by Europeans who have killed gravid females and found the like number of embryos in the uterus. This account is to some extent confirmed by observations on the Water-deer in captivity in Europe. Although the Zoological Society have not succeeded in inducing this animal to breed in the Regent's Park, this feat has been accomplished by M. Josephe Cornély of the

FIG 5—The Water-deer

Château Beaujardin, near Tours, in France—one of the most successful "acclimatisers" in Europe. In M Cornély's beautiful park one of these deer produced three young ones in the spring of 1879, two of which, it is believed, lived to attain maturity. There can be no doubt therefore that the Water-deer is much more fruitful than the rest of its congeners, which certainly never produce more than two at a birth, and for this reason at least would be a valuable animal for domestication.

The adult water-deer standing reached at its shoulder a height of about twenty inches, and is generally of a pale fawn-colour, paler below.

According to Mr Swinhoe the "Chinese at Shanghai call this animal the *Ke;* but at Chinkiang it is named *Chang*—the classical term for the Muntjac (*Cervulus Reevesi*). The Chinese dictionary, compiled under authority of the Emperor *Kanghe*, describes the *Ke* as 'stag-like, with feet resembling those of a dog, has a long tusk on each side of the mouth, and is fond of fighting'"

NOTES ON THE GEOLOGY OF THE COREAN ARCHIPELAGO[1]

THIS archipelago, which consists of a number of smaller groups of islands separated by a depth of water varying from twenty to fifty fathoms, lies off the south-west coast of the peninsula of Corea. Whilst many of the larger islands vary from two to six miles in their extreme length, they are all of considerable height: their highest summits attain an elevation generally ranging between 600 and 1000 feet above the sea—Ross or Alceste Island, in the south-west corner of the archipelago, reaching to a height of as much as 1935 feet. The large and naked masses of rock which crown their summits give to these islands a somewhat rugged and uninviting aspect, and their quaint inhabitants view with ill-concealed dislike the presence of foreign ships within their waters

I was enabled to land on two occasions on the Island of Mackau—the largest of a group of islands bearing that name. About six miles in length, it possesses some half-dozen lofty peaks, which range in height from 800 or 900 feet to 1400 feet above the sea. Naked masses of quartzite or quartz-rock crown the summits and often compose the upper third of the hills, whilst a thick and dense growth of creepers, shrubs, and mimosas clothes the hill-slopes for their lower two-thirds. The quartzite passes insensibly into a compact quartzitic sandstone underlying it; and lower down this rock assumes a coarse-grained texture, occasionally containing pebbles of quartz embedded in it. From the nature of the ground it was difficult to find

[1] Made during a brief visit of H.M S. *Hornet* to these islands in October, 1878.

trustworthy signs of bedding in these rocks. Cropping out in the lower third of the hills—from the cliffs and the slopes immediately above them—are beds of a highly micaceous rock—greisen—and a gneissose rock sometimes approaching in its characters the typical gneiss, these beds are inclined at an angle of 15° to the east-north-east Veins of quartz are observed to traverse both these rocks, whilst occasionally a layer of quartz—an inch in thickness—separates contiguous beds

I had no opportunity of landing on any other islands of the archipelago, many of which in their general appearance resemble that of the Island of Mackau.

H. B GUPPY

NOTES

THE International Medical Congress which it is proposed to hold in London in the beginning of August will be the seventh of its kind. The previous meetings have been held biennially in the principal university towns of the Continent. At the last meeting in Amsterdam in 1879, a general wish was expressed that the next should be in England, and the wish having been informally communicated to the Presidents of the College of Physicians and the College of Surgeons, they called a meeting of presidents or other delegates of all the Universities, Medical Corporations, Public Medical Services, and the Medical Societies The proposal to hold the Congress in London was heartily agreed to, and an Executive Committee was appointed under whose direction, and, especially, by the energy of the General Secretary, Mr. MacCormack, a very large scheme has been arranged for the discussion of the most interesting questions in all the divisions of the Medical Sciences. The Meetings will be held in fifteen sections, in rooms of most of which the use has been granted by the University of London, the Royal Academy, and all the learned Societies at Burlington House Others have been engaged at Willis's Rooms The officers and councils of the several sections include, with very few exceptions, all the chief and most active teachers and workers in the several subjects of medical science and practice, not in London alone, but in all the universities and great towns in the United Kingdom. In so far as general consent to the design of the Congress may be regarded as a promise of success, all looks well, and the agreement of our own countrymen is well matched by the assurances of co-operation already received from a large number of the most distinguished medical investigators and practitioners in both the Old World and the New. About 4000 invitations were issued, and it is expected that the roll of members will include at least 2000 names. Of course there are large arrangements for receptions and various hospitalities, and for making London as agreeable and instructive as may be in August; but if the design in the programme of the Congress be fairly fulfilled, a great quantity of hard and useful scientific work will be well done.

AT a meeting of the American Academy of Arts and Sciences held in Boston, Massachusetts, on January 12, the Rumford medal was conferred on Prof Josiah Millard Gibbs, of Yale College, for his researches on Thermodynamics

WE regret to hear of the death of Prof. James Tennant, F.G S., the well known mineralogist. Mr. Tennant was the assistant and afterwards the successor of Mr Mawe, author of "Travels in Brazil," and of a "Treatise on Diamonds," and by adding to the series obtained by Mr. Mawe many fine specimens from every part of the globe, succeeded in thus forming a very large and valuable collection of minerals. Mr. Tennant was an excellent authority on gems, and his advice was taken by the Government with respect to the cutting of the Koh-I-Noor and other crown jewels. Besides holding the office of "Mineralogist to the Queen," Mr. Tennant was for many years Professor of Geology and Mineralogy in King's College, London, and after he resigned the professorship of the former science, still retained the post of Professor of Mineralogy, which he held at the time of his death Mr Tennant, in conjunction with the late Prof. Ansted and the Rev. W. O. Mitchell, wrote the treatise on Geology, Mineralogy, and Crystallography for Orr's "Circle of the Sciences," and he was also the author of some smaller educational works Mr. Tennant did much useful work in preparing collections of minerals and fossils suitable for educational purposes, and by popular lectures and in other ways he aided in disseminating a knowledge of those sciences in which he was so greatly interested. Mr. Tennant had reached the age of seventy-three at the time of his death.

PROF MARTIN DUNCAN, F R S, has been elected president of the Royal Microscopical Society.

THE *Daily News* Naples correspondent writes with reference to the Zoological Station at Naples that the average number of naturalists working in the laboratory was formerly about twenty-five, but this year it will be above thirty, adding to which the permanent staff of the station, there are altogether nearly forty naturalists bent upon promoting original research into marine zoology and botany, while enjoying the most unusual facilities and elaborate technical arrangements that have ever yet been contrived. The use of the diving apparatus has enabled the naturalists to find marine plants hidden in cracks and crevices and on the undersides of overhanging rocks, which otherwise would never have been brought to light, for the ground-net cannot reach them. By this means many interesting botanical problems have been brought nearer to a solution

COLONEL PREJEWALSKI has just returned to St. Petersburg with a fine botanical collection he has made in Kansu Dr. Maximowicz states that upon a cursory examination his previous impression is strengthened that we have to do here not with the flora of China, but with an altogether different one, belonging to the border of the great Central Asiatic plateau There are no Chinese forms of trees or shrubs whatever, not even an Acer. The general character is entirely high alpine and cold. Dr Maximowicz thinks that this Central Asiatic plateau has a flora with a distinct individuality of its own, and proposes to call it the Tangut flora, from the name applied by its first European explorer, Marco Polo, to the people inhabiting this inclement and inaccessible region.

THE arrangements for the international medical and sanitary exhibition of the Parkes Museum of Hygiene, which is to be held at South Kensington from July 16 to August 13, are now complete. The exhibition is to comprise everything that is of service for the prevention, detection, cure, and alleviation of disease.

THE Clarendon Press is about to issue a new edition of the late Admiral W H Smythe's "Cycle of Celestial Objects," a book which by universal consent has done more to promote popular astronomy in England than any other work of the kind. The new edition has been edited by Mr G. F. Chambers, F.R.A S, whose "Handbook of Astronomy," another Clarendon Press book, is well known. This volume, though professedly only a new edition, may be regarded as almost a new work. Whereas the original edition comprised only 850 objects, the new one comprises no fewer than 1604 But it is not merely in the number of the objects dealt with that the usefulness of the new edition will consist. It will be found that Mr. Chambers has cut down here, expanded there, and revised everywhere, Admiral Smythe's printed matter, so as to embody the progress of the science down to the year 1880. What this means in the case of hundreds of double-stars annually undergoing re-measurement, and many of them annually undergoing change, can only be

understood by those who have been called upon to perform similar literary work. But this is not all. Admiral Smythe's observations having been made in England, his labours only extended to those stars and nebulæ which were visible in England; but Mr. Chambers, by means of materials gathered from various sources, has extended the book to the whole of the southern hemisphere, and has thus made it an observer's handbook for the large English-speaking populations of India and the Australian and American continents. The New "Cycle" will be found to contain a great number of double-star measures by Burnham and others, many of them as recent as 1880. The places of the objects have been uniformly set out for the epoch of 1890, so that in this respect the book will be up to date for many years to come. A chromolithograph of twenty four typical star disks in different shades of colour intended for the methodical record of star colours forms an appropriate frontispiece.

WE have received a very satisfactory report from the Sunday Lecture Society It refers to an interesting experiment in Edinburgh of a Sunday Science School, in which ninety-two pupils were enrolled, with an average attendance from November to July of sixty The pupils were mostly of the artisan class and youths who, owing to late business hours, could not avail themselves of evening classes

MEASUREMENTS of the "Midgets" who have lately been to Buckingham Palace and Marlborough House are being taken by Quarter-Master Sergeant Riordan, under the direction of the Anthropological Society. Successful casts of the mouths, showing an apparently abnormal dentition, have been obtained by Mr. F. S Mosely, and were exhibited in the library of the Royal Institution last Friday evening.

AT a meeting of the Electricity Exhibition Commission in Paris on Monday, M. Berger announced that arrangements had been made for the Palace of Industry being lighted up during the exhibition by all the French and foreign systems concurrently This will involve 800 horse power, and more than 50 kilometres length of wire There will be six classes, viz. —1. Production de l'électricité, 2 transmission de l'électricité; 3 électro-métrie, 4. applications de l'électricité, 5 mécanique générale dans ses applications aux industries électriques, 6 bibliographie et histoire. A proposal will be made to the Municipal Council of Paris to grant to Herr W. Siemens the concession of an electrical railway to the Hippodrome, in the Bois de Boulogne, in consideration of the expenses incurred by the construction of the railway from Place de la Concorde to the Exhibition Palace. The railway being constructed on a viaduct, the expense is estimated at 300,000 francs, and it is impossible to expect it will be recovered during the 107 days of the exhibition. The transmission of force at a distance by electricity will be tried in the Palais de l'Industrie during the Electrical Exhibition Currents generated in the ground-floor will be utilised to work electro-magnetic machines, which will do various kinds of work The Publishers' Union, under the direction of MM. Hachette, will establish an exhibition of electrical publications, and a reading-room, into which will be admitted all the scientific papers of the world, irrespective of their language

THE difficulties in the way of taking the census of our vast and heterogeneous Indian Empire have been sometimes very curious. In Burmah the census operations in the interior created no little consternation among the Karens, who were doing all they could to evade enumeration. The native officials employed to collect statistics seem to have shown their zeal in a curious way. The *Pioneer* declares that a census enumerator in the Central Provinces put down in his book a certain old tomb as a "house with one inhabitant." The phrase "to be numbered with the dead" will henceforward bear a new and vital meaning, and death will be robbed of his majority. Another anecdote states that when the census commissioner entered a certain compound with the forces of enumeration in his train, an ayah who had been taken account of by enumerator and supervisor both, ran excitedly to her mistress and warned her that there would be certainly some mistake in the hisab, for that the sirkar had counted her twice already and was going to count her again!

IN a note on the Russian and Siberian varieties of the *Gammarus pulex* (*Memoirs* of the St. Petersburg Society of Naturalists, vol xi. fasc. 1) M. Semenovsky shows that the representatives of this species in Lake Baikal and in Lake Gokcha of High Armenia, 6400 feet above the sea-level, are quite identical, and most akin to the Norwegian typical representative of this species, described by Prof. Sars. On the contrary, the *G. pulex*, which inhabits the lakes of the Taimyr *tundras* of Northern Siberia, that of the Baraba Steppe in Western Siberia and of the Ural region, belongs to another variety. A second variety, very different from the two preceding, was discovered in two salt lakes of the Government of Orenburg, notwithstanding the close proximity of one of these lakes to those of the Ural region A third variety inhabits the northern lakes of European Russia and those of the Valdai Hills, whilst a fourth variety, being most like to that which is known from the lakes of Savoy, was discovered in the lakes near St. Petersburg

IT is known that the young horns of the *Cervus maral* (Severtzoff), when they are filled with blood and not yet ossified, are very much prized by the Chinese, who purchase them at the Siberian frontier, paying as much as six to twenty pounds the pair. A very active chase of the maral has therefore always been carried on in Siberia, and since it became rather rare, the Cossacks in the neighbourhood of Kiakhta have domesticated this stag Now we learn from a communication by M. Polakoff that its domestication has greatly extended in Western Siberia, so that there are herds of seventy head, but the horns of the domesticated deer, as might be expected, have lost a good many of their original qualities

IN a recently discovered stalactite cave at Kirchberg, near Kremsmünster (Austria), a jaw-bone of a man with well-preserved teeth was found among numerous remains of *Ursus spelæus*.

IT is reported from Stuttgart (Wirtemberg) that bones of mammoth and rhinoceros have been brought to light by digging in a cellar on loamy ground. Dr. Fraas has recognised, besides tusks (60 cm and 200 cm. long), two pieces of a jaw-bone belonging to a mammoth, and parts of mandibles, scapula, and maxilla of a rhinoceros.

THE Mineralogical Museum at Breslau University has received a large number of bones belonging to the woolly-haired Rhinoceros (*Rhinoceros tichorhinus*). They were found near Skarsine in Silesia The complete skeleton was found in a marl-pit at a depth of sixteen feet Unfortunately the skull and several bones were broken through inattention on the part of the workmen. This is the fifth skeleton of the kind found in Silesia.

ON February 20 a slight shock of earthquake occurred at Agram at 2h. 15m. a.m., and a more severe one at 6h. 15m a m., accompanied by a subterranean noise. During the last week wave-like motions were also felt.

THE *Daily News* Lisbon correspondent, telegraphing on February 23, states that thirty-six successive shocks of earthquake have been experienced at St Michael's in the Azores. "The church and 200 houses fell in. Several people were killed. A religious and penitential procession had taken place, the Civil Governor at the head. A volcanic island has been formed. At latest advices slight shocks continued. Many people were in tents outside the town."

THE Khedive of Egypt has nominated M. Gaston Maspero to the directorship of the museums in the place of the late archæologist, M. Mariette. To the latter a monument is to be erected at Cairo. A committee has already been formed, of which the Foreign Minister is president

A NEW Italian serial will shortly be published at Naples Its title will be *Rassegna critica di opere scientifiche e letterarie*, and its editor Prof. Andrea Angiulli. It will appear six times a year.

LAST Thursday the Hackney Microscopical and Natural History Society held their annual *soirée*, always a very successful event Many other similar London societies were represented at the meeting

AN elaborate report upon the opening up of two of the pyramids at the boundary of the Libyan Desert near Sakkara is now published by Prof. Brugsch. The learned professor estimates the matter to be of the most important and valuable kind. At the close of 1880 the entrances to the sepulchral chambers of the three pyramids were laid bare. The ceilings were taken off, and only the two sides, all covered with hieroglyphics, rose from the *débris*. The hieroglyphics point to the reign of Pharaoh Apappus

THE additions to the Zoological Society's Gardens during the past week include a Bactrian Camel (*Camelus bactrianus*) from Afghanistan, presented by Col O B. C St John, R.E, F Z S, a Punjaub Wild Sheep (*Ovis cycloceros*) from Afghanistan, presented by Capt. W Cotton, a Mona Monkey (*Cercopithecus mona*) from West Africa, presented by Mr. W. Macmillan Scott, two Common Peafowls (*Pavo cristatus*) from India, presented by Mrs. Edward Brown, a Roseate Cockatoo (*Cacatua roseicapilla*) from Australia, presented by Miss Mary J. Richardson; a Stump tailed Lizard (*Trachydosaurus rugosus*) from Australia, presented by Mr. F. O. Maitland, a Horsfield's Tortoise (*Testudo horsfieldi*) from Cabul, deposited, two Globose Curassows (*Crax globicera*) from Central America, a White-browed Amazon (*Chrysotis albifrons*) from Honduras, purchased

GEOGRAPHICAL NOTES

WE take the following from the March number of the *Proc* of the Royal Geographical Society —The eminent Russian traveller and *savant*, Col. Prejevalsky, intends, we are informed, to devote himself for some time to the preparation in retirement of a great work on the results of his travels, including, besides his recent expedition to Tibet, his previous journey to Lob-nor, of which he was prevented, by want of time, from giving more than a bare outline. The work is to consist of eight volumes, and to be entitled "Travels in the Deserts of Central Asia" Volumes i. and ii. will contain the narrative and an account of the physical geography and ethnography of the countries he has visited, and will include also his surveys, the pictorial illustrations being from original sketches by his companion, Lieut Robarofsky Vol. iii. will be devoted to the mammalia of Central Asia, vol iv. to the birds, vol. v. to the reptiles, amphibia, and fishes, vol. vi. to the flora of Mongolia; and vol. vii to that of Tibet Vol. viii and last will contain the geology and mineralogy as far as materials will permit. The first two volumes, each containing 500 pages, and perhaps more, will be written by the traveller himself, and will appear towards the close of 1882 The ornithology will also proceed from his pen, as well as that portion of the zoology which treats of the antelope, buffalo, and a few other of the more important animals. The remainder will be written by the Academicians Strauch and Maximovitch, Professors Kepler, Inostrantsef, and Bogdanof, and will be issued in parts. The whole will not be completed for several years The work will be brought out under the auspices of the Geographical Society, and a special grant for the purpose will be asked for from H.M the Emperor

AT the Geographical Society on Monday evening Sir Richard Temple delivered a lecture on the lake-region of Sikkim on the frontier of Tibet, which, in point of fact, was a description of the impressions acquired during a tour which he made as Lieut.-Governor of Bengal Sir R. Temple told his audience that the fact of any part of Sikkim being British territory was due to the imprisonment of Sir Joseph Hooker and Dr. Campbell by the Rajah, and he then gave a geographical sketch of the whole region. Possibly the most important matter dealt with was the construction of the politico-commercial road from Darjiling to the Jyalap Pass into the Chumbi Valley, which Sir R. Temple considers the frontier line between British and Chinese territory. Sir R Temple is apparently sanguine that the Tibetans will continue the road on to Lhasa, but he did not say when they were likely to do so. Mr W T. Blanford, who had also visited Sikkim, afterwards explained to the meeting that he believed these lakes to be due to glacial action, and that the Bidan Tso was a beautiful specimen of this kind of lake. Mr Blanford also called attention to the opening afforded for exploration in Northern Sikkim, which has not as yet been visited by Europeans.

WE understand that Mr Joseph Thomson has been elected a life-member of the Royal Geographical Society, in further recognition of his eminent services to geography during the recent East African expedition. The Council of the Society have presented to the British Museum the collection of shells which he made during his journey.

THE *Oesterreichische Monatsschrift fur den Orient* of this month contains a highly interesting paper by Prof H Vambéry, on the proposed Hyrkanian railway, a valuable description of the roads and land communications of Persia by Baron Godel-Lannoy in Teheran, a paper on the coffee districts of Yemen by Baron Schweiger-Lerchenfeld, besides two well-written historical papers.

AT the last meeting of the Berlin Geographical Society Prof. W. Forster, the director of the Berlin Observatory, made an interesting communication regarding one of the most important tasks of travellers in unknown regions, *i e.* the exact determination of latitude, longitude, and elevation above sea-level With several of the results of recent German expeditions serious errors in this regard were detected Prof Forster stated that the Berlin Observatory staff would shortly be in a position to undertake the practical and theoretical instruction of travellers and to superintend the selection, testing, and packing of the necessary scientific instruments for the various expeditions before starting.

THE last number of the *Tour du Monde* contains an instalment of Dr. Crevaux's account of his journey from Cayenne to the Andes, the present part dealing more particularly with the exploration of the River Parou The illustrations are from original sketches, and are admirably drawn.

IN a recent issue *Les Missions Catholiques* publishes a letter from a missionary among the Kakhyens, which contains some interesting notes concerning that comparatively unknown people

A SYDNEY telegram states that a bushman named Skulthorpe has telegraphed from Blackall asserting that he has found the explorer Leichhardt's grave, and has recovered the diary of the whole of his last expedition, together with other relics. Skulthorpe refuses to show any of the articles until his arrival in Sydney

THE last number of *Le Globe* contains part of a paper entitled "Tartarie," by M. F. de Morsier, in which the writer proposes to deal with the Tartar, Turcoman, and Kirghiz steppes.

BY a telegram from Brisbane we learn that the Queensland Government expedition for the survey of the projected Trans-continental railway started on January 14, presumably from Blackall. A previous survey, it will be remembered, was made by a party under Mr Favene, despatched by the proprietors of the *Queenslander*, but so far as we are aware no detailed account of his explorations has ever been made public, and possibly the new expedition has been sent to endeavour to find a better line of route.

THE Wellington correspondent of the *Colonies and India* states that the Southern Alps and other of the principal mountains of New Zealand are to be explored next year by members of the Alpine Club, who will find ample scope for their energies. The top of Mount Cook, the loftiest peak in New Zealand, between 13,000 and 14,000 feet in height, has not yet been reached.

THE International Alpine Congress will meet at Salzburg in 1882. The committee is now being formed.

ON THE VISCOSITY OF GASES AT HIGH EXHAUSTIONS[1]

BY the viscosity or internal friction of a gas is meant the resistance it offers to the gliding of one portion over another. In a paper read before the British Association in 1859 Maxwell[2] presented the remarkable result that on theoretical grounds the coefficient of friction, or the viscosity, should be independent of the density of the gas, although at the same time he stated that the only experiments he had met with on the subject did not seem to confirm his views.

An elaborate series of experiments were undertaken by Maxwell to test so remarkable a consequence of a mathematical theory; and in 1866, in the Bakerian lecture for that year,[3] he published the results under the title of "The Viscosity or Internal Friction of Air and other Gases." He found the coefficient of friction in air to be practically constant for pressures between 30 inches and 0.5 inch; in fact numbers calculated on the hypothesis that the viscosity was independent of the density agreed very well with the observed values.

The apparatus used by Maxwell was not of a character to admit of experiments with much lower pressures than 0.5 inch.

Maxwell's theory that the viscosity of a gas is independent of the density presupposes that the mean length of path of the molecules between their collisions is very small compared with the dimensions of the apparatus; but inasmuch as the mean length of path increases directly with the expansion, whilst the distance between the molecules only increases with the cube root of the expansion, it is not difficult with the Sprengel pump to produce an exhaustion in which the mean free path is measured by inches, and even feet,[4] and at exhaustions of this degree it is probable that Maxwell's law would not hold.

The experiments recorded in this paper were commenced early in 1876, and have been continued to the present time. In November, 1876, the author gave a note to the Royal Society on some preliminary results. Several different forms of apparatus have since been used one after the other, with improvements and complexities suggested by experience or rendered possible by the extra skill acquired in manipulation. The earlier observations are now of little value, but the time spent in their prosecution was not thrown away, as out of those experiments has grown the very complicated apparatus now finally adopted.

The Viscosity Torsion Apparatus, with which all the experiments here given have been performed, is a very complicated instrument. It consists essentially of a glass bulb, blown with a point at the lower end, and sealed on to a long narrow glass tube. In the bulb is suspended a plate of mica, by means of a fine fibre of glass 26 inches long, which is sealed to the top of the glass tube, and hangs vertically along its axis. The plate of mica is ignited and lamp-blacked over one-half. The tube is pointed at the upper end, the upper and lower points are 46 inches apart, and are accurately in the prolongation of the axis of the tube. Sockets are firmly fixed to a solid support, so that when the tube and bulb are clamped between them they are only able to move around the vertical axis. The glass fibre being only connected with the tube at the top, rotating the tube on its axis communicates torsion to the fibre, and sets the mica plate swinging on the same axis without giving it any pendulous movement. The diameter of the fibre is about 0.001 inch. The viscosity apparatus is connected to the pump by a flexible glass spiral, so as to allow the apparatus to rotate on the pivots and at the same time to be connected to the pump altogether with sealed glass joints. An arm working between metal stops limits the rotation to the small angle only which is necessary.

The torsional movement given to the mica plate by the light of the candle shining on it or by the rotation of the bulb and tube on its axis by the movement of the arm between the stops, is measured by a beam of light from a lamp, reflected from a mirror to a graduated scale.

The pump employed has already been described. The measuring apparatus is similar to that described by Prof. McLeod[1] before the Physical Society, June 13, 1874. As it contains several improvements shown by experience to be necessary when working at very high vacua, a detailed description is given in the paper.

When taking an observation the arm is moved over to the stop, and in a few seconds allowed to return to its original position by the action of a spring. This movement rotates the viscosity apparatus through a small angle, and sets the mica plate vibrating, the reflected line of light traversing from one side of the scale to the other in arcs of diminishing amplitude till it finally settles down once more at *zero*.

The observer watching the moving index of light records the scale number reached at the extremity of each arc. The numbers being alternately on one and the other side of zero are added two by two together, to get the value of each oscillation. The logarithms of these values are then found, and their differences taken; the mean of these differences is the logarithmic decrement per swing of the arc of oscillation. For the sake of brevity this is called the log dec.

A very large number of experiments have been made on the viscosity of air and other gases. Observations have been taken at as high an exhaustion as 0.02 M, but at these high points they are not sufficiently concordant to be trustworthy. The pump will exhaust to this point without difficulty if a few precautions are taken, but at this low pressure the means of measuring fail in accuracy.

The precautions which experience shows to be necessary when exhausting to the highest points are fully described in the paper.

Viscosity of Air.—The mean of a very large number of closely concordant results gives as the log decrement for air for the special apparatus employed, at a pressure of 760 millims. of mercury and a temperature of 15° C., the number 0.1124. According to Maxwell the viscosity should remain constant until the rarefaction becomes so great that we are no longer at liberty to consider the mean free path of the molecules as practically insignificant in comparison with the dimensions of the vessels.

The author's observations show that this theoretical result of Maxwell's is at least approximately and may be accurately true in air up to comparatively high exhaustions, and that at higher exhaustions the viscosity falls off, as it might be expected to do according to theory.

The results are embodied in a table and diagrams.

The first half of the table gives the viscosity of air, in so far as it is represented by the log dec., at pressures intermediate between 760 millims. and 0.76 millim. (1000 millionths of an atmosphere). In order to avoid the inconvenience of frequent reference to small fractions of a millimetre, the millionth of an atmosphere[2] (= M) is now taken as the unit instead of the millimetre. The second half of the table is therefore given in millionths, going up to an exhaustion of 0·02 millionth of an atmosphere.[3]

Starting from the log dec. 0.1124 at 760 millims., the viscosity diminishes very regularly, but at a somewhat decreasing rate. Between 50 millims. and 3 millims. the direction is almost vertical, and a great change in the uniformity of the viscosity curve commences at a pressure of about 3 millims. At this point the previous approximation to, or coincidence with, Maxwell's law begins to fail, and further pumping considerably reduces the log decrement.

From 1000 M the diminution of viscosity is very slight until the exhaustion reaches about 250 M., after that it gets less with increasing rapidity, and falls away quickly after 35 M. is reached.

The curves of increasing mean free path and diminishing viscosity closely agree. This agreement is more than a mere coincidence, and is likely to throw much light on the cause of viscosity of gases.

[1] Abstract of a paper read before the Royal Society, February 17, 1881, by William Crookes, F.R.S.

[2] *Phil. Mag.*, 4th ser. vol. xix. p. 31.

[3] *Phil. Trans.* 1866, part 1, p. 249.

[4] Thus, supposing the mean free path of the molecules of air at the ordinary pressure is the 1-10,000th of a millimetre, at an exhaustion of the ten-thousandth of an atmosphere the mean free path will be 1 millim. At one-millionth of an atmosphere the mean free path will be 10 centimetres, and at an exhaustion of one hundred millionth—by no means a difficult point to attain with present appliances—the mean free path will be over 30 feet. This rarefaction corresponds to that of the atmosphere at a height above the earth of a little more than ninety miles, assuming that its density decreases in geometrical progression as its height increases in arithmetical progression, and neglecting the small corrections for diminished gravity and temperature. As the height above the earth increases, the length of the mean free path of the molecules of air rapidly approaches to planetary distances; at about 200 miles height the mean free path is 10 million miles, whilst between eighty and ninety miles higher the rarity is such that the mean free path would extend from here to Sirius.

[1] *Philosophical Magazine*, vol. xlviii. p. 110, August, 1874.

[2] M = 0.00076 millim.; 1315.789 M = 1 millim.

[3] To give some idea of the high exhaustions at which its measurements can be taken it may be mentioned that the highest exhaustion on the table—0.02 M.—bears about the same proportion to the ordinary atmospheric pressure that 1 millimetre does to thirty miles, or, converting it into time, that one second bears to twenty months.

In the table is also given the measurements of the repulsion exerted on the blackened end of the mica plate by a candle-flame placed 500 millims. off. The repulsion due to radiation commences just at about the same degree of exhaustion where the viscosity begins to decline rapidly, and it principally comes in at the exhaustions above 1000 M.

The close agreement between the loss of viscosity and the increased action of radiation is very striking up to the 35 millionth, when the repulsion curve turns round and falls away as rapidly as the viscosity.

Experiments are next described on the resistance of air to the passage of an induction spark.

Since the publication of the author's researches on the phenomena presented by the passage of the induction discharge through high vacua, the present results—which, although never published, precede by a year or two those just mentioned—have lost much of their interest.

The phenomena at the very high exhaustion of 0·02 M may be of interest. With a coil giving a spark 85 millims long, no discharge whatever passes. On increasing the battery power till the striking distance in air was 100 millims. the spark occasionally passed through as an intermittent flash, bringing out faint green phosphorescence on the glass round the end of the — pole.

On one occasion the author obtained a much higher exhaustion than 0·02 M. It could not be measured, but from the repulsion by radiation and the low log dec. it was probably about 0·01 M. The terminals of the vacuum tube and wires leading to them were well insulated, and the full power of a coil giving a 20-inch spark was put on to it. At first nothing was to be seen. Then a brilliant green light flashed through the tube, getting more and more frequent. Suddenly a spark passed from a wire to the glass tube, and pierced it, terminating the experiment.

Since these experiments vacua have frequently been got as high, and even higher, but the author has never seen one that would long resist a 20-inch spark from his large coil.

Viscosity of Oxygen.—The series of experiments with air show a complete history of its behaviour between very wide limits of pressure. It became interesting to see how the two components of air, oxygen and nitrogen, would behave under similar circumstances. Experiments were therefore instituted exactly as in the case of dry air, but with the apparatus filled with pure oxygen.

The results are given in the form of tables and plotted as curves on diagrams.

The figures show a great similarity to the air curve. Like it the log dec. sinks somewhat rapidly between pressures from 760 millims. to about 75 millims. It then remains almost steady, not varying much till a pressure of 16 millims is reached. Here however it turns in the opposite direction, and increases up to 1·5 millim. It then diminishes again, and at higher exhaustions it rapidly sinks. This increase of viscosity at pressures of a few millimetres has been observed in other gases, but only to so small an extent as to be scarcely beyond the limits of experimental error. In the case of oxygen however the increase is too great to be entirely attributable to this cause.

Oxygen has more viscosity than any gas yet examined. The viscosity of air at 760 millims, being 0·1124, the proportion between that of air and oxygen, according to these results, is 1·1185.

This proportion of 1·1185 holds good (allowing for experimental errors) up to a pressure of about 20 millims. Between that point and 1 millim. variations occur, which have not been traced to any assignable cause; they seem large to be put down to "experimental errors." The discrepancies disappear again at an exhaustion of about 1 millim., and from that point to the highest hitherto reached the proportion of 1·1185 is fairly well maintained.

Viscosity of Nitrogen.—The proportion between the viscosities of nitrogen and air at a pressure of 760 millims is, according to these experiments, 0·9715.

A comparison of the air curves with those given by oxygen and nitrogen gives some interesting results. The composition of the atmosphere is, by bulk,

Oxygen	20·8
Nitrogen	79·2
	100·0

The viscosity of the two gases is almost exactly in the same proportion: thus at 760 millims—

$$\frac{20{\cdot}8 \text{ vis. O} + 79{\cdot}2 \text{ vis. N}}{100} = \text{vis. air},$$

$$\frac{20{\cdot}8\,(0{\cdot}1257) + 79{\cdot}2\,(0{\cdot}1092)}{100} = \quad ,,$$

$$\frac{2{\cdot}61456 + 8{\cdot}64072}{100} = 0{\cdot}11255,$$

a result closely coinciding with 0·1124, the experimental result for air. Up to an exhaustion of about 30 M the same proportion between the viscosities of air, oxygen, and nitrogen is preserved with but little variation. From that point divergence occurs between the individual curves of the three gases.

Observations on the Spectrum of Nitrogen.—Spectrum observations during exhaustion give the following results:—

At 55 millims pressure the band spectrum of nitrogen commences to be visible. The red and yellow bands are easily seen, and the green and blue are exceedingly faint. As the pressure grows less the bands become more distinct, until at 1·14 millim. the band spectrum is at its brightest.

At a little higher exhaustion a change comes over the spectrum, and traces of the line spectrum are observed.

At 812 M both the band and the line spectrum can be seen very brilliantly.

At 450 M the line spectrum is seen in great purity. As the exhaustion becomes higher the lines commence to disappear at the two ends of the spectrum.

At 188 M the lines below λ 610 ms of m m at the red end, and above λ 400, cease to be visible.

At 94 M a bright greenish yellow line is visible at about λ 567.

At 55 M this greenish yellow line is still very prominent. The red lines have disappeared altogether, and the highest blue line visible is one at λ 419. The line 567 varies much in visibility; sometimes it cannot be seen, whilst at others it is very visible. Thus—

At 40 M the line 567 has quite disappeared.

At 17 M line 567 is visible again, being the most prominent line left.

At 12 M line 567 is not seen, although several other green and blue lines are left.

At 3 M only three lines are visible in the green, and these are very faint.

At 2·8 M line 567 is detected again.

At 2 M only traces of one or two lines can be seen, the faint light of the lines being overpowered by the green phosphorescence of the glass.

Line 567 has been seen on several occasions at high exhaustions when the gas under examination has been mixed with a little air. It is probably a nitrogen line, for one of the most brilliant nitrogen lines has a wave-length of 567·8 (Thalén), 568·0 (Huggins), or 568·1 (Plucker), and the author's interpolation curve is not sufficiently accurate to enable him to say that the line entered in as being at 567 may not in reality be a trifle higher. The reason of its being only sometimes visible may be accounted for by a difference in the sensitiveness of the eye at different times, or by a difference in battery power. This however cannot be the whole explanation, for other lines are not found to vary in the same manner.

The curve of Repulsion exerted by Radiation is much lower than in oxygen or air, and sinks rapidly after the maximum is passed.

Viscosity of Carbonic Anhydride.—The curves of this gas are given in diagrams plotted from the observations. At first the curve seems to follow the same direction as the air curve. But at a pressure of about 620 millims it slopes more rapidly till the pressure is reduced to about 50 millims, when the curve again takes the direction of the air curve. The total diminution between 760 millims. and 1 millim. is nearly double that of air.

Observations have also been taken with the spectroscope during the exhaustion of carbonic anhydride. The maximum brilliancy of the spectrum occurs at an exhaustion of about 300 M. After that it gets fainter; at about 75 M the blue band (λ 409 to 408 ms. of mm.) disappears; as the exhaustion gets higher the other bands vanish until, at a vacuum of about 40 M, nothing is visible but the two lines λ 519 and λ 560. At higher exhaustions these lines disappear, and the phenomena of "Radiant Matter" commence.

The proportion between the viscosity of carbonic anhydride and air at 760 millims. is 0·9208.

Viscosity of Carbonic Oxide.—The results with this gas are remarkable as showing an almost complete identity with those of nitrogen both in position and shape. The viscosity at 760 millims. is in each case 0·1092.

Like that of nitrogen the curve of carbonic oxide is seen to be vertical—*i.e.*, assuming the curve to represent the viscosity, the gas obeys Maxwell's law, at pressures between 90 millims. and 3 millims. The straight portion in nitrogen is at a little higher pressure—between 100 millims. and 6 millims.

The curve of repulsion resulting from radiation is lower in carbonic oxide than in any other gas examined, and, unlike the other gases, there is no sudden rise to a maximum at about 40 M. At lower exhaustions the curve is, however, higher than it is in nitrogen.

During exhaustion observations were continued on the variations in the spectrum. The ordinary band spectrum is first seen with a few sharp lines terminating the bands.

At 12 millims. pressure a sharp green line is first seen, λ 515 ms of mm. This line rapidly grows brighter as exhaustion continues, and then fades out, it is last seen at a pressure of about 0·9 millim. This line is probably the bright oxygen-line, the wave-length of which is given by Plucker at 514·4.

At a pressure of 2·8 millims. the spectrum agrees in appearance with the "Carbon No. 2" in Watts's "Index of Spectra."

At 553 M the bands between the sharp lines appear to be breaking up into masses of fine lines.

At 211 M these fine lines are distinctly visible. The brightness of this spectrum is now near its maximum.

At 100 M the general spectrum is growing faint, but a sharp green line at λ 534 makes its appearance by fits and starts. This is coincident with Plucker's bright oxygen line λ 534.

After this degree of exhaustion the spectrum rapidly gets fainter. The line λ 534 soon disappears, and the carbon lines also go one after the other, until at an exhaustion of 4 M only two lines are visible, λ 560 and λ 519.

Viscosity of Hydrogen.—It has been found that hydrogen has much less viscosity than any other gas, the fact of the log dec. not decreasing by additional attempts at purification is the test of its being free from admixture. This method of ascertaining the purity of the gas, by the uniformity of its viscosity coefficient at 760 millims., is more accurate than collecting samples and analysing them eudiometrically.

Several series of observations in hydrogen have been taken. For a long time it was considered that hydrogen, like other gases, showed the same slight departure from Maxwell's law of viscosity being independent of density that appeared to be indicated with other gases, for the log dec. persistently diminished as the exhaustion increased, even at such moderate pressures as could be measured by the barometer gauge. Had it not been that the rate of decrease was not uniform in the different series of observations, it might have been considered that this variation from Maxwell's law was due to some inherent property of all gases. After working at the subject for more than a year it was discovered that the discrepancy arose from a trace of water obstinately held by the hydrogen. Since discovering this property extra precautions (already described at the commencement of the paper) have been taken to dry all gases before entering the apparatus.

The remarkable character of hydrogen is the uniformity of resistance which it presents. It obeys Maxwell's law almost absolutely up to an exhaustion of about 700 m., and then it commences to break down. Up to this point the line of viscosity is almost perfectly vertical. It then commences to curve over, and when the mean free path assumes proportions comparable with the dimensions of the bulb and approaches infinity, the viscosity curve in like manner draws near the zero line.

The repulsive force of radiation is higher in hydrogen than in any other gas. It commences at as low an exhaustion as 14 millims., but does not increase to any great extent till an exhaustion of 200 M is attained; it then rises rapidly to a maximum at between 40 and 60 M, after which it falls away to zero. The maximum repulsion exerted by radiation in hydrogen is to that in air as 70 to 42·6. This fact is now utilised in the construction of radiometers and similar instruments when great sensitiveness is required.

Taking the viscosity of air at 760 millims. as 0·1124, and hydrogen as 0·0499, the proportion between them is 0·4439.

The Spectrum of Hydrogen.—The red line ($\lambda = 656$), the green line ($\lambda = 486$), and the blue line ($\lambda = 434$) are seen at their brightest at a pressure of about 3 millims., and after that exhaustion they begin to diminish in intensity. As exhaustion proceeds a variation in visibility of the three lines is observed. Thus at 36 millims. the red line is seen brightly, the green faintly, whilst the blue line cannot be detected. At 15 millims. the blue line is seen, and the three keep visible till an exhaustion of 418 M is reached, when the blue line becomes difficult to see. At 38 M only the red and green lines are visible, the red being very faint. It is seen with increasing difficulty up to an exhaustion of 2 M, when it can be seen no longer. The green line now remains visible up to an exhaustion of 0·37 M, beyond which it has not been seen.

It is worthy of remark that although when working with pure hydrogen the green line is always the last to go, it is not the first to appear when hydrogen is present as an impurity in other gases. Thus, when working with carbonic anhydride insufficiently purified, the red hydrogen line is often seen, but never the green or the blue line.

(To be continued.)

SEEING BY ELECTRICITY[1]

ON being called upon by the chairman to show his experiments, Prof. Ayrton stated that he and Mr. Perry thought that the occasion of the reading of Mr. Bidwell's paper was a suitable one for their showing to the Society that they were constructing the apparatus described by them in a letter in NATURE, vol. xxii. p. 31. The feasibility of their plan had been combated, and at the last meeting of the British Association at Swansea it was confidently asserted that the action of selenium was not quick enough to register rapid changes of light intensity—an idea, however, which they stated in the discussion at the time there was experimental evidence to disprove. After that came the publication and exhibition of the photophone, proving that selenium changed its electrical properties synchronously with rapid changes in light intensity. For a light telegraph however not only was this property necessary, but in addition that the electric changes in the selenium should be considerable for a comparatively small change in the light. They had, therefore, tried to make sensitive selenium cells of low resistance. The method they had employed consisted in winding two wires parallel on strips of box-wood, ivory, and other non-conductors in section, somewhat like that of a paper-knife in the manner subsequently described by Mr. Bidwell in NATURE, but they had not found it necessary to cut a screw on the wood or mica in a lathe. Of the twenty-five cells that they had constructed they had invariably found, like Mr. Bidwell, that only those were sensitive that had a high resistance. They were aware that Prof. Adams had made sensitive cells of low resistance, and had he been present they would have liked to ask whether it was not only for very small electromotive forces that the cells were sensitive. They had also found that when sensitive cells of 100,000 ohms resistance diminished in resistance to only a few hundred ohms by natural annealing extending over some months, the cells lost entirely their sensibility. Further that certain sensitive cells of high resistance were sensitive as long as an electromotive force of not more than about seven volts was employed to send a current through them, but for electromotive forces much above this the cells were comparatively unsensitive to light, but the sensibility was not destroyed for electromotive forces smaller than seven volts used subsequently. These phenomena, which they believed had not been previously noticed, pointed, they suggested, to the sensibility of selenium being due almost entirely to a polarisation and not merely to a change of resistance, as was commonly supposed and stated. Might it not be possible, they asked, that there was an electromotive force developed in selenium by light, which, for different cells, increased more rapidly than the resistance of the cell, and which was the greater, the greater the electromotive force of the auxiliary battery employed, that in fact selenium became rapidly polarised by the auxiliary current flowing through it, and that this polarisation, the amount of which depended on this current, was removed in proportion to the intensity of the light. That a small electromotive force was developed in selenium by light when no auxiliary current was sent through it, had been conclusively shown by Prof. Adams and Mr. Day in 1876, a result that they had also experienced; and they would mention that a careful examination which they had recently made of the paper published by Prof. Adams and

[1] Paper communicated to the Physical Society, February 26.

Mr. Day in the *Phil. Transactions* for 1876, showed that if we assumed *all* the instances therein mentioned of sensibility of selenium to light were due to an electromotive force set up, and not to change of resistance at all, then on the whole all the results would have been arrived at if this electromotive force set up in different cells, for the same intensity of light, increased more rapidly than the resistance of the cell, and was the greater, the greater the electromotive force of the auxiliary battery employed. They disagreed therefore from Mr. Bidwell in his idea that the name "cell" was at all inappropriate.

Professors Ayrton and Perry referred the Members to their original letter in NATURE for the account of their plan for seeing by electricity. Shortly, it consisted in projecting at the sending-station an image on a screen consisting of a number of selenium cells, the current flowing in each of which from an auxiliary battery was controlled by the intensity of the light falling on it. At the receiving-end of the line a light was thrown on a screen intercepted more or less by little shutters, the opening or closing of each of which was controlled by the current allowed to pass through the corresponding selenium cell at the sending end. Hence on the receiving screen a picture in mosaics was cast corresponding with the image projected on the screen at the sending-end, and varying with every change in the image cast on the sending-screen.

The experiment they desired to show the Society was the successful reproduction on the receiving-screen of every change of illumination of one square of the sending-screen The shutter was an elliptical blackened aluminium disk suspended in a blackened tube of a kind of galvanometer, and making an angle of 45° with the tube when all the light tending to pass through the tube was cut off. When this disk was deflected through 45° all the light passed through the tube and an image of a square hole was formed by a small lens attached to the tube. For every intermediate position of the shutter an image of the square hole was formed on the screen, but varying in intensity of illumination. Attached to the shutter was a small magnet making an angle of 67½° with it, and the two were suspended by a silk fibre about one-twentieth of an inch in length These particular angles were selected so that first all variation in intensity of the illumination could be produced with a small motion of the shutter, and secondly, so that the magnet should always be in its most sensitive position in the coil through which passed the electric current which traversed and was controlled by the corresponding selenium square at the receiving end of the line. [The apparatus was then shown in action.]

They explained how their method of putting, say, thirty or forty selenium cells on a revolving arm would enable them, while dispensing with a large number of cells, to transmit electrically a complete picture of even moving objects, and would in addition obviate the difficulty arising from abnormal variations of selenium.

Instead of the apparatus exhibited to the meeting to show the perfect feasibility of the scheme, Professors Ayrton and Perry mentioned that they were also experimenting with a large thin mirror with many thick ribs at the back crossing one another. Electro-magnets firmly fixed behind the thin parts of the mirror produced by their expansion and contraction very small convexities and concavities on the mirror's face. From their experiments, published in the *Proc*. Roy. Soc., on the so-called Japanese magic mirrors, it was known that excessively small convexities and concavities of this kind might be made to show themselves in a very decided way on a screen by a divergent beam of reflected light. They proposed to have a circular mirror in rotation, but with only a certain sectional space at the back fitted with electro-magnets as described, and they anticipated that this in conjunction with the rotating section of selenium cells at the other end of the line would produce on a screen a picture over the whole area of the mirror corresponding with the distant image projected on the area traced out by the revolving sector of selenium cells.

EARTH CURRENTS—ELECTRIC TIDES

AT a meeting of the Society of Telegraph Engineers and of Electricians on Thursday evening, February 10, Prof. G. C. Foster in the chair, a communication was read by Mr. Alex. J S. Adams upon "Earth Currents—Electric Tides," in which the author related that, from investigations he had carried on in connection with earth currents since the year 1866, he considered the globe we inhabit as an electrified sphere whose normal electrical condition was liable to disturbance both from within and from without. Starting upon this theory as a basis, and finding from the result of his observations no evidence that the sun exerted sufficient influence to materially disturb the earth's electricity, he undertook a series of systematic observations upon the daily earth-current variations in strength, to elucidate the question, and obtained consecutive observations every quarter of an hour during the interval from April 1 to 21, 1879, with a result that the curves of those observations coincided throughout with the curve of moon phases for the same period, and clearly indicated that the chief disturbing power was the moon, and that the earth current variations were strictly *lunar-diurnal*.

"But," said he, "there is a yet deeper meaning to the lunar-diurnal current curve than at first sight appears, for an examination shows that the curve for each day represents *four electrical maxima, two of a kind*, and that each maximum is divided from the other by a zero or point of no current." He further explained that whilst two of these maxima always exist upon the opposite sides of the globe, which are in a line *perpendicular* to the moon, two other maxima were also found upon the sides of the globe lying at right angles to the former maxima, and that from a long and careful consideration of these features of the phenomenon he had arrived at the conclusion that whilst the earth's disturbed electricity was, as it were, heaped up by the moon upon the sides of the earth nearest to and farthest from her, much as are the waters of the globe in forming the oceanic tides, the two *lateral* maxima, upon the other hand, must be considered as parts of a belt or band of electrical maximum that encircles the earth in a position at right angles to a line drawn between the earth and moon. Thus it appeared that there were zones of maxima at the sides of the globe nearest to and farthest from the moon, and a *circle* of maximum at right angles between them, but divided from them by zones of no current. This arrangement of the earth's electricity by the moon the author termed the earth's *lunar electric distribution*, the electric maximum facing the moon he designated the *major electric pole*, that farthest from the moon the *minor electric pole*, and the belt of maximum that encircles the earth the *electric circle*. Likewise the zone of no current that divides the electric circle from the major pole he terms the *major zero circle*, and that zero which separates the electric circle from the minor pole, the *minor zero circle*

The earth's electricity, as thus arranged by the moon, followed that orb in her course through the heavens, and this motion of the earth's disturbed electricity round the earth, yet irrespective of the globe itself, was termed the *lunar diurnal electric circulation*, and the axis upon which it turned the *lunar-diurnal axis*.

A due apprehension however that *the moon's influence is in proportion felt by the earth's electricity at every part of the earth's surface* he considered necessary for the proper appreciation of the reasonings which led to the foregoing deductions.

It was then pointed out that there existed a regular retardation or lagging of the earth current variations behind the corresponding phases of the moon to the extent of nearly three hours, this curious phenomenon being in no way, so far as he could trace, attributable to solar influence.

The magnetic variations were then considered, and a striking coincidence between the electric and the magnetic lunar-diurnal variation-curves was shown to obtain The author reasoned that the earth's electric forces as constituted in the *electric distribution* revolved also about an axis parallel to a line passing through the centres of the earth and moon, *i.e.* a line drawn between the major and minor electric poles—a motion of the electric forces that agreed with the *observed direction* of the earth current, and which appeared fully sufficient to account for the effect of lunar-diurnal magnetic variation.

In conclusion he said that a comprehensive consideration of earth-current phenomena opens out a much wider sphere of investigation than that simply embracing variations of strength · it has to recognise *directive influence* which, applied to electricity, means the production of magnetism, and that the electric circulating systems that appear to obtain by reason of these three motions, the *earth's diurnal rotation*, the *lunar current circulation*, and the *terrestrial current circulation*—causes which result in the apparently disconnected variations observable in the movements of the magnetic needle.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The examiners for the Natural Science Tripos during this year are Dr. W. H. Gaskell, Prof. Bonney, Mr P. T. Main, Prof. Watson (Owens College), Prof. Lewis (recently

appointed Professor of Mineralogy), Messrs. W. Garnett, F. M Balfour, and S H. Vines.

The Rev. W. Cunningham, M.A., of Trinity College, has been appointed Deputy for the Knightbridge Professor, Prof. Birks, and has resigned the Assistant-Secretaryship of the Local Examinations and Lectures Syndicate.

Mr. W. Hillhouse, B.A., of Trinity College, Assistant-Curator of the Botanical Museum, has been approved as a teacher of botany, and Mr J. J. Lister, B A., of St John's College, Demonstrator of Comparative Anatomy, as a teacher of that subject for the purposes of medical certificates.

It was resolved last Thursday to admit women students at Cambridge to the Previous Examination and to the various Tripos Examinations, to publish separate class lists for women, and in cases where order of merit is indicated in the men's class-lists, to indicate the position which any female student would have taken in the corresponding list of men. The examiners may also state that any candidate who does not attain an honour standard is adjudged to have deserved an ordinary degree It will be necessary to present a further report on minor details of fees and regulations, but it can hardly be doubted that students duly qualified may be admitted formally to the examinations coming on in June next

The University accounts just published show that examiners cost the University last year 2200*l*, professors, demonstrators, lecturers, &c., 8400*l*., in addition to those specially endowed. The ordinary expenses of the museums and lecture-rooms have been 2500*l*, while the grant from the University is 2000*l*. The botanic garden has cost nearly 1000*l*, and 660*l*. has been so far spent on a curator's house The Local Examinations and Lectures Board have received 8400*l*., and have invested a further sum of 500*l*., which at a future time may help to provide a building for this extensive work. The University Library has overdrawn its balance nearly 900*l*., and the Museums and Lecture Rooms Building Fund is in debt 2725*l* On the whole it appears that the University has been very careful not to sanction new expenditure in this time of transition, and has succeeded in laying by 3000*l*., now possessing a capital of 27,000*l* in stocks 3000*l* was the University's income last year from common rents and dividends, while 27,000*l*. was paid by members of the University in fees for examinations, degrees, &c.

In the Special Examinations for the ordinary B A degree last year thirty-six candidates entered in Chemistry, nine of whom failed, two in Geology, nine in Botany, only one failed, viz. in Botany. The examiners report that in Chemistry the requirement of practical work has exerted a useful influence This requirement however entails much additional work on the examiners in Natural Science, and the appointment of a third examiner is recommended.

Next Monday at three o'clock, Dr W H Gaskell will make a communication to the Philosophical Society on the action of the vagus nerve upon the frog's heart, and Mr F. M. Balfour will discuss the ancestral form of the chordata.

The Calendar of St David's College, Lampeter, for 1881, is of interest in connection with the forthcoming report of the Commission on Higher Education in Wales. It contains a full account of the foundation and history of the University, the means at its disposal, and the nature of the education it offers to students. The examination for the B.A degree of this college includes either physics or chemistry.

SCIENTIFIC SERIALS

Archives des Sciences Physiques et Naturelles, No. 1, January 15 —Contributions to knowledge of the family of the Pintinnodea, by H. Fol —On the use of the microphone in the service of the astronomical hour, by M. W Meyer —Exercises of analytical geometry, by L. de la Rive.—On the use of some azoic colours in physiological chemistry, by A. Danilewsky —*Comptes rendus* of the Geneva Chemical Society, by S Walter.—On the botanical geography of Southern Tessin, by S. Calloni.—Annals of Berne Observatory, by A. Forster.

Rivista Scientifico Industriale, No. 24, December 31, 1880.—Description of three new species of the aphides of Sardinia, by L. Marchiati

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti, vol xiii. fasc. xx —On the rotatory movement of the heart, by E. Oehl.—On a new nuclearia; description and considerations as to its position in the geological system and its importance in animal ontogeny, by L. Maggi.—Registering instruments in meteorology, by C. Chistoni.—Synthesis of two new acids isomeric with vanillic acid, by G. Korner and G. Bertoni

SOCIETIES AND ACADEMIES

LONDON

Royal Society, January 27.—"On the Iron Lines widened in Solar Spots" By J Norman Lockyer, F R S.

The observations put forward with reserve in my last communication to the Society have now been confirmed

In the fine spots visible on December 24, January 1 and 6, many lines in the spectrum of iron were seen contorted, while others were steady.

The facts are given in the following table —

	The iron lines indicating motion	Iron lines, visible in the same field of view, steady
Dec. 24, 1880	5403·2	
	5404·8	5410·0
	5409·0	5414·5
	5408·8	
	5396·0	
	5370·5	
	5369·0	5366·5
	4919·8	
	4918·0	4923·0
	5142·2	5269·8
	5138·5	5268·5
In another part of the same spot—		
	5269·8	5323·5
	5268·5	5327·0 (double)
Jan. 1, 1881	5323·5	5269·8
	5327·0 (double)	5268·5
Jan 6,[1] 1881	4919·8	
	4918·0	4923·5
	All lines between λ 5323·5 and 5410·0 except	5382·1

It is to be noted that these observations furnish us with an instance of inversion similar to those frequently obtained in our observations of the most widened lines in spots.

The inferences to be drawn from these observations, and those on which we are now continuously engaged, must be matter for future communication But I cannot resist calling attention to the crucial nature of the evidence, at least as regards iron, in favour of the view first put forward by Sir B Brodie, whom we have so recently lost, that the constituents of our terrestrial elements exist in independent forms in the sun.[2]

I have thought it right to send in a record of this work at once, with a view to induce other observers to follow the continually varying phases of the spots during the approaching maximum

The observations have been made by Mr. H. A. Lawrance, and confirmed by myself in the majority of cases

Chemical Society, February 17.—Prof Roscoe, president, in the chair —The following papers were read —On the estimation of organic carbon and nitrogen in water analysis simultaneously with the estimation of nitric acid, by M W. Williams. The author has modified the well-known process of Frankland and Armstrong. Instead of reducing the nitrates with sulphurous acid, he uses the copper-zinc couple of Gladstone and Tribe, which converts nitrates into ammonia. The ammonia produced is distilled off and the distillate nesslerised, the water left in the retort, after distilling off the ammonia, is evaporated to dryness and the residue burnt in the ordinary way. The errors which accompany the use of sulphurous acid are thus avoided, and the time required for the analysis is much shortened.—Capt. Abney and Col. Festing then gave an account of their recent researches on the influence of the molecular grouping in organic bodies on their absorption in the ultra-red region of the spectrum. The authors have photographed the absorption-spectra of numerous inorganic and organic liquids in the region beyond the red. In many cases the presence of an organic radical seems to

[1] In this spot the D lines indicated motion, and *did not retain their parallelism*

[2] Lecture delivered before the Chemical Society, June 6, 1867.

be characterised throughout its compounds by particular bands. Further research will probably throw much light on the internal structure of chemical substances.—On absorption bands in the visible spectrum produced by certain colourless liquids, by Dr. Russell and Mr. Lapraik. The authors have carefully drawn the absorption-spectra of various liquids—water, ammonia, &c.—as seen through an ordinary spectroscope.—On the action of hydrochloric acid on ethylene alcohol, by C. Schorlemmer. By heating glycol with an excess of fuming hydrochloric acid in a sealed tube to 100° the author has converted this substance into ethylene dichloride, and has thus disproved the conclusion that the two hydroxyl groups had different functions.—On an attempt to accelerate the process of determining the soluble salts in a soil, by E. W. Prevost. The author added calcium sulphate and barium carbonate to the soil, but in neither case were satisfactory results obtained.

Linnean Society, February 17.—Frank Crisp, LL.B., F.L.S., in the chair.—Mr. Wickham exhibited two collections of Arctic plants. Of fifty-seven species collected by Capt. Markham in Novaya Zemlya (1879) thirty-seven of the most interesting Phanerogams were shown. The absence of species of Gentian is noteworthy, for Arctic Russia, in proximity, possesses six species. Leguminosæ are unrepresented in Spitzbergen and Arctic Greenland, but three species of the order obtain in Novaya Zemlya. Other features of the latter island's flora are equally remarkable. The second collection of typically Polar plants exhibited were those obtained by Mr. Grant in Mr. Leigh Smith's successful voyage to Franz-Josef Land, 1880, and where sixty-one flowering plants were obtained, though the facies of the flora indicates the probability of more yet to be got in this high latitude.—Mr. A. Hammond drew attention to a microscopic specimen and drawing of portion of the wall of the so-called glandular sac of the larva of the Puss moth, from which that insect ejects an acid liquid when alarmed or irritated. Although doubtless the organ is the source of the excretion, it yet is questionable to regard it as a true glandular structure, inasmuch as its tissue is largely composed of chitinous matter.—Dr. Francis Day read a paper, observations on some British fishes. In this he pointed out:—that *Pimelepterus Cornubiensis* is identical with the American *Pammelas perciformis*, Mitchell; that great confusion exists in the works of Yarrel and Couch respecting the Tunnies and their allies, most, if not all, the examples of the short finned Tunnies being in reality specimens of *Pelamys sarda*; that the Comber Wrasse (*Labrus Donovani*, Cuv. and Val.), is a peculiarly-coloured variety of *L. maculatus*, Bloch.; that *Crenilabrus Baillonii*, Couch, is the *C. melops*, Cuv. and Val. Adult examples of Brill and Sole, coloured on both sides, but in which the eyes were normal, were exhibited. Some Sprats obtained off St. Ives were adverted to, which had fully-developed ova in January this year. It was also proved that the specimen of *Ostracion quadricornis* figured by Couch as a British fish had been brought in salt from abroad by a sailor. Observations also were made by Dr. Day concerning the habits of the Thresher Shark towards the Whale.—Mr. C. B. Clarke gave a communication on right hand and left hand contortion of the corolla. In this he maintains that Linnæus's definition of right-hand contortion is correct, and that the criticisms published by M. Alph. de Candolle in "Phytographie" are founded on a misconception. Mr. Clarke holds:—that everybody understands the same direction (viz. the watch-hand direction) by the term right-hand contortion; that the apparent direction of the heavenly bodies is reversed if the spectator looks north instead of south; that the direction of rotation is the same whether the observer supposes himself within or without the helix, but that the apparent direction of a helix is altered if the spectator reverses the direction in which he looks along the axis.—Prof. P. M. Duncan read a paper on some sponges obtained among a mass of fistulose coral from deep water off the coast of Spain during the expedition of the *Porcupine*. One kind, apparently new, is described as a species of *Leodermatium*, *L. affine*, Dunc., and another belongs to the genus *Aphrocallistes*.

Geological Society, February 18.—Annual General Meeting. Robert Etheridge, F.R.S., President, in the chair.—The Secretaries read the Reports of the Council and of the Library and Museum Committee for the year 1880, the Council announcing with much satisfaction that the financial depression under which the Society had been suffering during 1878 and 1879 had proved, as was anticipated, only temporary, and that the Society is now in a very prosperous condition. The Council's Report also announced the publication of the new Catalogue of the Library, which, although considerably larger than was at first expected, will be issued to the Fellows at the price originally fixed for it. The Report further announced the awards of the various medals and of the proceeds of the donation funds in the gift of the Society. In presenting the Wollaston Gold Medal to Prof. P. Martin Duncan, M.B., F.R.S., F.G.S., the President addressed him as follows:—Professor Duncan,—It is with no ordinary pleasure that the Council have awarded to you the Wollaston Medal, the highest honour that it is in their power to bestow, in recognition of the valuable services which you have rendered during so many years to the advancement of geology, and especially of palæontology; and I may add that it is equally productive of gratification to me that this honour is to be formally conferred upon you by my hands. Since the year 1863 palæontologists have been indebted to you for no fewer than twenty-six memoirs relating to the history, structure, and distribution of the fossil Actinozoa, a group which you have made peculiarly your own by long-continued and most careful researches. Further, you have enriched the publications of the Palæontographical Society with several most important treatises on the British fossil corals, supplementary, or rather perhaps complementary, to the classical monograph of MM. Milne-Edwards and Haime. These labours alone, and the value of their results, might have justified the Council in awarding you the Wollaston Medal; but besides your researches upon the Actinozoa, we have to point to several important papers upon the fossil Echinodermata, to others relating to subjects of physical geology (also freely touched upon in your more special memoirs), and particularly to your exceedingly important work in connection with the Geological Survey of India, in describing the fossil corals of that peninsula, and discussing the questions of both zoological and geological interest which naturally arise out of the study of those organisms. Patiently and unobtrusively for nearly twenty years you have followed out the line of research necessary for the fulfilment of your self-imposed task; you have sacrificed the advantages of professional life to devote your energies to the advancement of science. On all accounts it is with much pleasure that I hand to you the Wollaston Medal. The President then presented the Murchison Medal to Prof. Archibald Geikie, F.R.S., F.G.S., and addressed him as follows:—Prof. Geikie,—If any one Fellow of our Society more than another could be selected to receive the Murchison Medal for his valuable contributions to geology, it would be yourself, since no man living has contributed more to the advancement of that science which it is the special object of our Society to cultivate and diffuse. Your labours in the field connected with your duties as Director of the Geological Survey of Scotland, your learned and valuable contributions to the *Journal* of our Society, the *Transactions* of the Royal Society of Edinburgh and the Glasgow Geological Society, and other publications too numerous to mention, eminently qualify you to be the recipient of the medal founded by your late chief and friend Sir Roderick Murchison. To enumerate your contributions to the literature of the geology of Scotland, or your many important writings connected with our science, would lead me too far—some thirty papers, besides educational works, have resulted from your industry and knowledge. Your able paper alone, on the "Old Red Sandstone of Scotland," published in the *Transactions* of the Royal Society of Edinburgh, would entitle you to the highest consideration of the Society. Able indeed are other contributions, especially those "On the Chronology of the Trap Rocks of Scotland," "On the Date of the Last Elevation of Central Scotland" (in vol. xviii. of our *Journal*), "On the Phenomena of Succession amongst the Silurian Rocks of Scotland" (*Trans.* Glasgow Geol. Soc. vol. iii.), and "On Earth Sculpture." The President next handed the Lyell Medal to Mr. Warington W. Smyth, F.R.S., for transmission to Dr. J. W. Dawson, F.R.S., of Montreal, and addressed him as follows:—Mr. Warington Smyth, I need hardly say that the Council, in awarding the Lyell Medal to Principal Dawson, have done so with a sincere appreciation of the high value of his truly great labours in the cause of palæontology and geology. When I refer to his published papers I find that they number nearly 120, and that they give the results of most extensive and valuable researches in various departments of geology, but more especially upon the palæontology of the Devonian and Carboniferous formations of Northern America. Considering the nature of these numerous contributions, the Council would have been fully justified in awarding to Dr. Dawson one of its medals, upon the

sole ground of the value of their contents; but these are far from representing the whole of the results of his incessant activity in the pursuit of science His "Acadian Geology," "Post-pliocene Geology of Canada," and "Fossil Plants of the Devonian and Upper Silurian of Canada," are most valuable contributions to our knowledge of North American geology, whilst in his "Archaia," "The Dawn of Life," and other more or less popular writings he has appealed, and worthily, to a wider public We are indebted to his researches for nearly all our knowledge of the fossil flora of the Devonian and other Precarboniferous rocks of America, and of the structure and flora of the Nova-Scotian coal-field; and finally I must refer especially to his original investigation of the history, nature, and affinities of *Eozoon*. These researches are so well known that they have gained for Dr Dawson a world-wide reputation The President then handed the Bigsby Medal to Prof Morris, F G.S, for transmission to Dr Charles Barrois, and addressed him as follows —Professor Morris, Dr Barrois's chief or most important work (written in the year 1876, and published at Lille) is "Recherches sur le terrain cretacé supérieur de l'Angleterre et de l'Irlande," a production almost exhaustive in its description of the cretaceous rocks of England and Ireland, and of the utmost value to English students of geology Dr. Barrois in this work has been the first to attempt to arrange the English Cretaceous rocks in palæontological zones, and eminently has he succeeded in defining and correlating the horizons of France and Britain. In handing to Prof. J. W. Judd, F.R S, Sec G S, the balance of the Wollaston Donation Fund for transmission to Dr. Ramsay H. Traquair, F.G S., the President said —Professor Judd, in handing to you, to be forwarded to Dr. Traquair, the balance of the proceeds of the Wollaston Donation Fund, I have to request that you will inform him of the feeling of the Council, that it is rarely that they can have the opportunity of awarding this fund to a more able and accomplished naturalist than himself His long-continued researches upon the ganoid fishes of the Carboniferous formation have rendered his name eminent in this department of palæontology The President next presented the balance of the proceeds of the Murchison Donation Fund to Mr. Frank Rutley, F.G S, one moiety of the balance of the proceeds of the Lyell Donation Fund to Mr. G. R Vine, the second moiety of the Lyell Donation Fund to Prof H G Seeley, F.R S, F G S., for transmission to Dr. Anton Fritsch, of Prague The ballot for the council and officers was taken, and the following were duly elected for the ensuing year President, R. Etheridge, F.R.S., Vice-Presidents John Evans, F.R S, J. W. Hulke, F.R.S, Prof J. Morris, M A, and H C Sorby, F.R S, Secretaries Prof. T. G. Bonney, F R S, Prof J. W Judd, F R S Foreign Secretary, Warington W. Smyth, F R S; Treasurer, J Gwyn Jeffreys, F R S Council H Bauerman, Rev J. F Blake, M A, Prof T G. Bonney, F.R.S, W Carruthers, F R S., Prof P M Duncan, F R.S, Sir P de M Grey-Egerton, Bart, M.P, F.R.S, R Etheridge, F R S, John Evans, F R.S, Lieut.-Col H H. Godwin-Austen, F R.S, J Clarke Hawkshaw, M.A, Rev. Edwin Hill, M A, W. H Hudlestone, M A, J W Hulke, F R S, J. Gwyn Jeffreys, F.R.S., Prof J. W. Judd, F.R.S, Prof N. S. Maskelyne, M.P, F R S, J Morris, M.A, J A Phillips, F. W. Rudler, Prof H. G Seeley, F.R S., Warington W. Smyth, F.R.S., H C. Sorby, F.R.S., H Woodward, F R S.

Zoological Society, February 15.—Prof W. H. Flower, F.R.S., president, in the chair.—The Secretary read a report on the additions that had been made to the Society's Menagerie during the month of January, and called special attention to a White-nosed Saki (*Pithecia albinasa*), purchased January 11, an American Monkey of the genus *Callithrix*—probably referable to *C. brunnea*, purchased along with the preceding, and an example of an Insectivore of the genus *Tupaia* (probably *T. tana*), obtained by purchase on the same day.—Mr. Sclater exhibited and made remarks on some eggs of *Opisthocomus cristatus*, obtained at Obydos on the Amazons.—Mr. Howard Saunders exhibited on behalf of Capt. E. A. Butler, and made remarks on specimens of the eggs of *Dromas ardeola*.—The Rev O. P. Cambridge, C M Z.S., exhibited and made remarks on a Hymenopterous parasite, hatched from larvæ found on two spiders—*Linyphia obscura*, Blackw. ♀ and *L. zebrina*, Menge ♂. The larvæ were stated to be apodous, and to adhere to the abdomen of the spider, which, when full-grown, they fully equalled in size.—Mr. E. W. H. Holdsworth exhibited a specimen of White's Thrush (*Turdus varius*), killed in South Devonshire in January last.—Mr. C. O. Waterhouse read a paper on the Coleopterous Insects belonging to the family *Hispidæ*, collected by Mr. Buckley in Ecuador Seventeen species of *Hispidæ* had hitherto been recorded as inhabiting that country; of these Mr Buckley had met with fifteen, which, together with nineteen new species, made a total of thirty six species in the series now described —Mr W. L Distant read a paper on some additions which had been lately made to the Rhynchotal Fauna of the Ethiopian Region, nine new species belonging to the families *Pentatomidæ*, *Coreidæ*, and *Pyrrhocoridæ* were pointed out, and in the *Coreidæ* two new genera, allied to *Petillia* and *Petascelis*, were described. The specimens had been obtained from Western, Southern, and Eastern Africa —A communication was read from Mr. Edgar A Smith on some shells from Lakes Tanganyika and Nyassa and from other localities in East Africa, lately received by the British Museum Great interest attached to some of the shells from Lake Tanganyika, from the fact that they had all the appearance of being modified marine types.—Lord Walsingham read a paper on some new and little known species of North American Tineidæ, amongst which were three new generic forms.

Meteorological Society, February 16—Mr G J Symons, F R S, president, in the chair.—I L Bell, F R S, J Bernays, A. W Blyth, J Church, F. W Cory, S Cutler, T L. K Edge, C Horsley, W D Howard, C Kelly, M.D, G Lingwood, W Macgeorge, Capt J. P Maclear, R N, A Rigg, and H C Stephens were elected Fellows of this Society —The following papers were read:—Relative humidity, by Charles Greaves, M. Inst C.E, F G S The object of this paper was to show that the term "relative humidity" was frequently the cause of misunderstanding, and that it was desirable that some other tables with a more correct denomination should be used in order that reliable values of this factor in our climate should be recorded —On the frost of January, 1881, over the British Isles, by William Marriott, F M S The author pointed out that the severe frost of the 7th to the 26th was remarkable for its unexpected appearance, its long continuance, and its sudden breaking up. The weather during the first week of January was comparatively mild, but frost set in over the north of Scotland on the 5th. The author then gave the lowest thermometrical readings from about 300 stations in the United Kingdom for each day of the frost, which were plotted upon diagrams, clearly showing the relative severity of the weather experienced in each district The lowest readings were − 15° at Garstang on the 16th, and − 22° at Blackadder, − 16° at Kelso, − 15° at Stobo, − 11° at Thirlestane Castle, and − 10° at Melrose, on the 17th Reference was also made in detail to the rivers and lakes which had been frozen over, and to other incidents proving the remarkably low temperatures which had occurred Some idea of the intensity of the frost may be gathered by the fact that in the south of Scotland the temperature fell below 10° on more than eleven occasions, below 20° on nineteen occasions, and was below 32° on twenty-five to twenty-nine occasions. In the London district readings below 10° occurred on two or three days, below 20° on ten days, and below 32° on twenty days In Ireland temperatures below 10° were registered on six or seven occasions, below 20° on twelve or fourteen occasions, and below 32° on twenty-two to twenty-four occasions. No place in the British Isles was exempt from the frost, even at Scilly the temperature was below 32° on three days, the lowest being 29° on two occasions. The winter sea-side health resorts afforded no protection from the frost, at Penzance the temperature fell below 32° on ten occasions, at Torquay on eleven occasions, and was below 20° on six occasions. At Ventnor it was below 32° on nineteen occasions, and below 20° on three occasions, and at Bournemouth it was below 32° on twenty-three, and below 20° on ten occasions. The heavy falls of snow prevented the frost from penetrating far into the ground, but where the snow was cleared away the temperature of the soil fell considerably A diagram was exhibited showing the mean temperature of January, in the neighbourhood of London, for each year, from 1774 to 1881, from which it appeared that the low mean temperature of 31°·6 for last month had only been surpassed on five occasions, and that the three years, 1879-81, have been very cold, the mean for this period being only 32°·2, there is no instance during the past 100 years of any three consecutive Januarys having so low a mean temperature

Royal Microscopical Society, February 9 (Anniversary Meeting).—Dr Beale, F.R.S, president, in the chair —The Report of the Council showed an addition of forty-nine Fellows

during the year (making 611 in all), with a considerable increase in the revenue and capital accounts of the Society. The attendance at the meetings was also shown to have increased by nearly 50 per cent. The President read his annual address, in which he dealt with the theory of evolution. A vote of thanks was passed by the meeting on the occasion of his retirement from the presidency, as also to the retiring treasurer, Mr. J. W. Stephenson.—The following Council was elected for the ensuing year:—President, Prof. P. Martin Duncan, F.R.S.; Vice-presidents: Prof. F. M. Balfour, F.R.S., W. B. Carpenter, C.B., F.R.S., John Millar, L.R.C.P. Edin., John Ware Stephenson; Treasurer, Lionel S. Beale, F.R.S.; Secretaries, Charles Stewart, M.R.C.S., Frank Crisp, LL.B., B.A.; Members of Council, Robert Braithwaite, M.D., Charles James Fox, William H. Gilburt, James Glaisher, F.R.S., A. de Souza Guimaraens, William J. Gray, M.D., John E. Ingpen, John Matthews, M.D., John Mayall, jun., Albert D. Michael, Frederic H. Ward, M.R.C.S., C. Tharters White, M.R.C.S.

Photographic Society, February 8.—J. Glaisher, F.R.S., president, in the chair.—A paper on sensitometers was read by Leon Warnerke. After alluding to those already existing, he exhibited and explained one of his own, the "standard sensitometer." This consisted of a frame constructed to hold a thin block made of phosphorescent calcium sulphide mixed with paraffin, and made luminous by burning one inch of magnesium ribbon in close proximity; next to the glass, having upon it a series of squares (with consecutive figures on them) increasing in opacity; then a photographic plate, or any other material sensitive to light, is placed in front, and the phosphorescent light is then permitted to pass through the glass containing the squares; and the highest number visible represents the sensitiveness of the matter experimented upon; the numbers enabling relative values to be determined.

Statistical Society, February 15.—Mr. Jas. Caird, C.B., F.R.S., president, in the chair.—A paper was read on the number of deaths from accident, negligence, violence, and misadventure in the United Kingdom and some other countries, by Mr. Cornelius Walford, Barrister-at-Law, wherein he reviewed the numbers and causes of deaths of this class from the earliest periods at which records existed in the United Kingdom, bringing them down also to the latest date, and noting the circumstances which had helped to increase them, as also those which had a retarding influence. He was of opinion, supported by the statistics adduced, that violent deaths of various kinds had advanced with the progress of civilisation. New forces, as also increasing mechanical productiveness, rendered the risk to life and limb continually greater.

PARIS

Academy of Sciences, February 14.—M. Wurtz in the chair.—The following papers were read:—Progress of the zoological station of Roscoff, by M. de Lacaze-Duthiers. Since 1872 there have been 114 workers of various nationalities at the station, the numbers rising from three in 1872 to twenty-seven last year. Last August seventeen were accommodated at once. A keeper now stays at the station constantly, and despatches live animals to various laboratories in France. Zoologists can be lodged in winter. The station has a good sea-going vessel, and is about to acquire a diving-dress. (Particulars of the aquarium, laboratory, &c., are given.) A new station is being formed at Port Vendres, on the Mediterranean.—Existence of large spiral cells distributed in the parenchyma of certain *Crinum*, by M. Trécul.—Theorems relative to the equation of Lamé, by M. Brioschi.—On periodic movements of the ground, by M. Plantamour. In the year ending September 30, 1880, a great lowering took place on the east side, from October 4 to January 28, viz. 95″·80 (as against 28″·08 the previous year). The mean temperature of December was unusually low, but the author thinks some other cause must have operated also. The level placed in the meridian showed nearly the same oscillation as the previous year (4″·56). In winter the south side rises with rise of temperature; in summer it falls.—On the earthquake in Switzerland on Jan. 27, 1881, by M. Colladon.—Lithological and geological examination of the meteorite that fell on Oct. 13, 1872, in the neighbourhood of Soko Banja, in Servia, by M. M. Sunier.—On Fuchsian functions, by M. Poincaré.—On the laws which rule periods and coefficients of intensity in one of the principal groups of elementary electromotive forces due to solar induction, and on the possibility of using the magnetic needle to measure the velocity of rotation of the sun about its axis, by M. Quet.—On the relations which exist between the temperature, pressure, and circulation of the air on the Iberian peninsula, by M. Teisserenc de Bort. In winter the peninsula is colder than the seas around; it shows a barometric maximum, the air flowing outwards to the coasts. In summer the isotherms group round a maximum in the middle of Spain, where, on the other hand, the pressure shows a minimum, and the winds tend inwards. In intermediate seasons the isotherms are nearly perpendicular to the meridians; the isobars are grouped uniformly round great centres of atmospheric action, the most important being the oceanic barometric maximum. Spain is somewhat like monsoon countries. (The author also studies the action of the peninsula as revealed in daily phenomena).—On m'boundou (test poison of the Gaboonese), new physiological, chemical, histochemical, and toxicological researches, by MM. Heckel and Schlagdenhauffen. It contains only one alkaloid, strychnine. The division of *Strychnos* into *tetanising* and *paralysing* is unwarranted. The effect depends on the dose employed.—On the treatment of phylloxerised vines by insufflation of vapours of sulphide of carbon, by M. Bourdon. He sends the vapours through a permanent drainage-system.—The Secretary made reference to the death of M. Kuhlmann.—Researches on the specific magnetism of ozone, by M. Becquerel. Ozone is found to be more magnetic than oxygen, and the ratio of the one specific magnetism to the other is considerably greater than the supposed ratio of the densities. Thus the specific magnetism of ozone is greater than that corresponding to the quantity of oxygen contained in it.—On the electric phenomena of tourmaline and of hemihedral crystals with inclined faces, by MM. Jacques and Curie.—On the combination of hydrochloric acid with bichloride of mercury, by M. Ditte. These substances may unite in several proportions.—Violet illumination of the retina under the influence of luminous oscillations, by M. Charpentier. If the sky, uniformly illuminated by diffused white light, be looked at steadily, and two fingers (separate about 0·02 m.) passed to and fro rapidly before the eye for about half a minute, one perceives a mosaic system of hexagons of violet purple colour separated by white lines. The author supposes the hexagons to represent the cones in the fovea and yellow spot, and the white lines filaments from the choroidian cells.—Determination of fundamental colour sensations by study of the distribution of complementary colours in the chromatic circle (continued), by M. Rosenstiehl.—On a glucoside extracted from common ivy, by M. Vernet.—On cultivation of the microbe of rot, by M. Toussaint. This succeeds best in rabbit and mutton bouillon. The microbe appears in two states, that of bacteria and that of spores.—Structure and texture of the ink-bag of Sepia, by M. Girod.—Artificial reproduction of basalts, by MM. Fouqué and Lévy. They followed the igneous method. The peridote was crystallised at a higher temperature than the other minerals. The black earth used consisted of six of olivine, two of augite, and six of labrador.—Map of the central part of the Spanish Pyrenees, by M. Schroder.

CONTENTS

THURSDAY, MARCH 10, 1881

SIR WILLIAM HERSCHEL

I.

ON March 13, 1781, the planet *Uranus* was discovered by William Herschel, and very opportunely at this centenary of that memorable addition to the planetary system, Prof Holden has presented us with a popular biography of the great astronomer and an outline of his works, which he has been careful to make intelligible to the general reader [1]

Of the great modern philosophers, writes Prof Holden, that one of whom least is known, is William Herschel, and we may appropriate the words which escaped him as one of the starless spaces in the constellation Scorpio passed through the field of his telescope, when his sister Caroline Herschel, his constant attendant during his night-watches, tells us he exclaimed, "*Hier ist wahrhaftig ein Loch im Himmel*" A life of Herschel which shall be satisfactory in every particular, Prof. Holden remarks, can only be written after a full examination of the materials which may have been preserved by the family, but as two generations have passed since his death, he thinks no apology will be needed for a conscientious attempt to make the best use of material already in hand, scanty as it may be

Herschel did prepare, about the year 1818, a biographical note or memorandum, which was then placed amongst his papers, and which has not been made public, and his sister, writing in June, 1842, mentions having commenced a work which she almost despaired of finishing, "The History of the Herschels," in which presumably her brother's life and work would have formed the main feature, but we do not hear that in her then infirm state of health any considerable progress was made with it

The only authentic sources of biographical information before the world are in the "Memoir and Correspondence of Caroline Herschel," published in 1876, and in a much less known sketch of his life furnished by Herschel himself in a communication to Lichtenberg, dated November 15, 1783, and printed in the *Gottingen Magazine of Science and Literature*, in 4, this sketch was forwarded at the request of Lichtenberg, when acknowledging the receipt of memoirs on double stars, &c, which Herschel had sent him

William Herschel was born in Hanover on November 15, 1738, and was the second son of Isaac and Anna Herschel. The musical taste which he exhibited early in life appears to have been inherited from his father, who formed one of the band of the Hanoverian Guards in 1731 The eldest son Jacob was a clever musician, and first violin in the Court orchestra in 1759; he afterwards joined his brother William in this country, and on returning to Hanover carried on a correspondence with him on musical subjects till his death in 1792. The youngest brother Dietrich also shared in the musical abilities of the family, and at fifteen years of age was so far advanced as to be admitted into the Court orchestra. Towards the end of 1755, when the Hanoverian Guards were ordered to England, Herschel accompanied them as one of the band, and remained in this country about a year, when he returned to Hanover During part of the disastrous campaign of 1757 he was on active service with the regiment, but after the defeat at Hastenbeck in July, it became evident that he had not the physical strength for the service, and his parents resolved to remove him. In connection with this circumstance Prof. Holden recalls a statement made by Sir George Airy, that the "removal" was a desertion, as he was told by the Duke of Sussex that on Herschel's first visit to the king after the discovery of the *Georgium Sidus*, "his pardon was handed to him by the king himself, written out in due form."

Herschel returned to England, though at what time does not appear In fact from 1757 to 1760 we know nothing of his life. It is related in the Memoirs of Caroline Herschel that several pages referring to this period had been torn out in both her original Recollections and in the unfinished Memoir commenced in 1840 In 1760, however, he is again heard of, at Pontefract, as a young German in the band of the Durham militia, who spoke English almost as well as a native, and who was an excellent performer on the violin It is conjectured that till his appointment as organist at Halifax in 1765, pupils and public concerts must have filled up his time; during a portion of this interval of five years he resided at Leeds, and in April, 1764, we are told he returned to Hanover on a very brief visit In 1766 he obtained an engagement at Bath, and soon after was appointed organist at the Octagon Chapel. In this year, says Prof Holden, he began a life of unceasing activity His engaging manners made him friends, while "his talents brought him admirers and pupils, and pupils brought him money"; at this time he was giving thirty-five or more musical lessons in a week In August, 1772, he proceeded to Hanover to take back to England his sister Caroline, afterwards his untiring assistant and companion in his surveys of the heavens At this time his residence was in New King Street, Bath, and here in 1774 he had made himself a Gregorian telescope, probably on the model of Short's In the preceding year, it is related of him, that he used to retire to bed with Smith's Harmonics and Optics, Ferguson's Astronomy, &c, and his first thoughts on rising were how to obtain instruments for viewing the objects of which he had been reading We are told no optician had settled in Bath at that time.

Prof Holden mentions that in *Journal* No 1, preserved at the Royal Society, is a copy of Herschel's first observation of the nebula of Orion, made with his $5\frac{1}{2}$-feet Gregorian reflector on March 4, 1774 In 1775, with a Newtonian telescope of $4\frac{1}{2}$ inches aperture, and power of 222, also made by himself, he made his first review of the heavens, consisting in the examination of every star of first to fourth magnitudes and the planets, no records of these observations are now known to be in existence In the same year the first 7-feet reflector was finished, and in 1777 one of 10 feet and one of 20 feet had been projected, and a grass-plot behind a house near Walcot turnpike, to which Herschel had removed at midsummer, 1774, was prepared for its reception this house offered more room for workshops, and the roof was available for observations Of his early attempts at the construction of telescopes he wrote to Lichtenstein "When, in the

[1] "Sir William Herschel, his Life and Works" By Edward S Holden, U S. Naval Observatory, Washington (New York: Charles Scribner's Sons, 1881.)

course of time, I took up astronomy, I determined to accept nothing on faith, but to see with my own eyes everything which others had seen before me. Having already some knowledge of the science of optics, I resolved to manufacture my own telescopes, and after many continuous, determined trials, I finally succeeded in completing a so-called Newtonian instrument, seven feet in length. From this I advanced to one of ten feet, and at last to one of twenty, for I had fully made up my mind to carry on the improvement of my telescopes as far as it could possibly be done" A very good twenty-feet reflector was finished in 1783, but the celebrated forty-feet instrument was not commenced until 1785 Herschel tells us in his description of the latter telescope that in all he made "not less than 200 7-feet, 150 10-feet, and about 80 20-feet mirrors, not to mention those of the Gregorian form, or of the construction of Dr Smith's reflecting microscope," of which he also made a great number.

In or about 1779 Herschel removed to 19, New King Street, which was his last change of residence at Bath, and it was at this house that the planet Uranus was discovered. His first astronomical paper, on the variable star Mira Ceti, was written from thence, and appeared in the *Philosophical Transactions* for 1780 he had previously contributed a paper (his first publication) to the *Ladies' Diary* in 1779, in answer to a prize question proposed by Landen, viz. "the length, tension, and weight of a musical string being given, it is required to find how many vibrations it will make in a given time, when a small given weight is fastened to its middle, and vibrates with it" In the same volume of the *Phil Trans* he published observations relating to the mountains in the moon; at this time and subsequently he measured the heights of about 100, on three different methods Most of these measures were never printed, and as Prof Holden remarks at this date they would probably be of no material service to science

His next paper presented to the Royal Society on January 11, 1781, is entitled "Astronomical Observations on the rotation of the Planets round their Axes, made with a view to determine whether the Earth's Diurnal Motion is perfectly equable," a paper which Prof Holden views as affording the first obvious proof of the truth of the statement made by Herschel thirty years later, when he said, "A knowledge of the construction of the heavens has always been the ultimate object of my observations" It marks too an advance in practical astronomy: not only are the results given, but careful estimates of the errors to which they may be liable is made, with a discussion of the source of such errors

On March 13 following Herschel made his great discovery of the planet *Uranus*, that *Georgium-Sidus*, as it was his wish it should be called, which made his name at once familiar throughout Europe. The discovery was announced in a paper communicated to the Royal Society on April 26 by Dr Watson of Bath, an intimate friend of Herschel's, and strange as it may now appear to us, it is entitled "Account of a Comet." His own words referring to the circumstances of the discovery are as follows —"On Tuesday, the 13th of March, between ten and eleven in the evening, while I was examining the small stars in the neighbourhood of H Geminorum, I perceived one that appeared visibly larger than the rest: being struck with its uncommon magnitude, I compared it to H Geminorum and the small star in the quartile between Auriga and Gemini, and finding it so much larger than either of them, suspected it to be a comet. I was then engaged in a series of observations on the parallax of the fixed stars, . . . and those observations requiring very high powers, I had ready at hand several magnifiers of 227, 460, 932, 1536, 2010, &c, all of which I have successfully used upon that occasion. The power I had on when I first saw the comet was 227 From experience I knew that the diameters of the fixed stars are not proportionally magnified with higher powers as the planets are; therefore I now put on the powers of 460 and 932, and found the diameter of the comet increased in proportion to the power, as it ought to be, on a supposition of its not being a fixed star, while the diameters of the stars to which I compared it were not increased in the same ratio Moreover, the comet being magnified much beyond what its light would admit of, appeared hazy and ill-defined with these great powers, while the stars preserved that lustre and distinctness which from many thousand observations I knew they would retain" The observations given in this paper extend to April 19, and Herschel adds he was "happy to surrender it to the care of the Astronomer-Royal" (Dr. Maskelyne) and others as soon as he found they had begun their observations upon it, so little idea had he six weeks after he first glimpsed the object of the great discovery he had made

It is certain that at the date of this discovery the name of Herschel was unknown to the principal astronomers on the Continent, and it is almost ludicrous to read of the various guesses that were made respecting it. Prof Holden transcribes the amusing passage from Bode's account of the discovery of *Uranus*. "In the *Gazette Littéraire* of June, 1781, this worthy man is called MERSTHEL, in Julius' *Journal Encyclopédique*, HERTSCHEL, in a letter from Mr Maskelyne to M Messier, HERTHEL, in another letter of Maskelyne's to Herr Mayer at Manheim, HERRSCHELL [doubtless mis-readings]; M Darquier calls him HERMSTEL. What may his name be? He must have been born a *German*" In the first notice of the discovery in the *Connaissance des Temps* he is called HOROCHELLE

The telescope which Herschel was using on the evening of March 13, 1781, was that with which his second review of the heavens was made, a reflector[1] of 85 2 inches focus, 6·2 inches aperture, and power, 227. This survey, he writes in 1783, "extended to all the stars of Harris's maps and the telescopic ones near them, as far as the eighth magnitude. The catalogue of double-stars and the discovery of the *Georgium Sidus* were the results of that review."

Arago says if Herschel had directed his telescope towards the constellation Gemini eleven days earlier (March 2 instead of March 13) the proper motion of the planet would have escaped him, for the planet was on the 2nd near one of its stationary points, and adds, "On voit par cette remarque à quoi peuvent tener les plus grandes découvertes astronomiques." This implies a total misconception of the case: as Prof. Holden remarks:—"The

[1] When Sir John Herschel contemplated presenting one of his father's 7-feet telescopes to the Royal Astronomical Society, Caroline Herschel wrote "Its only being painted deal was because it should look like the one with which the Georgium Sidus was discovered"

new planet was detected by its appearance and not by its motion." Herschel, referring to his discovery in his communication to Lichtenberg, says "This was by no means the result of chance, but a simple consequence of the position of the planet on that particular evening, since it occupied precisely that spot in the heavens which came in the order of the minute observations that I had previously mapped out for myself Had I not seen it just when I did I must inevitably have come upon it soon after, since my telescope was so perfect that I was able to distinguish it from a fixed star in the first minute of observation." It is not to be supposed that so striking an object would have been viewed once and forgotten, even if no motion were immediately detected

As is well known, Herschel feeling deeply his indebtedness to the liberality of George the Third, desired to testify his gratitude by giving his planet a name which would mark the epoch of its discovery, and in his letter on the subject addressed to Sir Joseph Banks, then president of the Royal Society, writes, "I cannot but wish to take this opportunity of expressing my sense of gratitude by giving the name Georgium Sidus,

Georgium Sidus
——*jam nunc assuesce vocari*,

to a star, which (with respect to us) first began to shine under his auspicious reign"

Prof. Holden dwells upon the changes which may be considered to have been effected in the state of astronomy not only in England but in the whole world, simply by the discovery of Uranus "Herschel's researches would have gone into the *Philosophical Transactions* as the work of an amateur astronomer, Mr. Herschel, of Bath. They would have been praised and they would have been doubted. It would have taken a whole generation to have appreciated them They would have been severely tried, entirely on their merits, and finally they would have stood where they stand to-day– unrivalled But through what increased labours these successes would have been gained! Certainly, if Herschel's mind had been other than it was, the discovery of Uranus, which brought him honours from every scientific society in the world, and which gave him authority, might have had a hurtful effect But as he was, there was nothing which could have aided his career more than this startling discovery It was needed for him It completed the solar system far more by affording a free play to a profoundly philosophical mind, than by occupying the vacant spaces beyond Saturn. His opportunities would have been profoundly modified, though his personal worth would have been the same" We think there are few astronomers who will not be able to follow Prof Holden in the views he has thus forcibly expressed

At the hands of Sir Joseph Banks, Herschel received the Copley Medal of the Royal Society in 1781, for his "discovery of a new and singular star," and was formally admitted a Fellow of the Society on May 30, 1782. It was during this visit to London that Herschel was received by the king, and as he wrote to his sister the same day, met with a very gracious reception. Prof Holden reproduces from the Memoirs of Caroline Herschel his letter of July 3, in which he describes his visit to the Court with a 7-feet reflector, and the evening having been very fine, how the instrument had given general satisfaction; the king in particular, he states, "enjoys observations with telescopes exceedingly" Herschel returned to Bath in the last week of July, and immediately prepared for removing to Datchet

Here, at the end of his second chapter, we close our present notice of Prof Holden's welcome volume, reserving for another week his third chapter on "Life at Datchet, Clay Hall, and Slough," and the concluding one on the general scientific labours of Herschel It should be stated that while taking Prof Holden's work as our text, particulars have been included in this notice which are not specially referred to in it, in view of the interest attaching to them at the present time, when, as stated above, a hundred years have elapsed since Herschel's discovery of *Uranus* doubled the known extent of the planetary system J R HIND

EXTINCT BRITISH ANIMALS

British Animals Extinct within Historic Times; with some Account of British Wild White Cattle By J E. Harting, F L S. (London · Trubner, 1880.)

THE wild animals formerly inhabiting Britain, which disappeared before the advance of the hunter and farmer in historic times, have hitherto only been treated in a disconnected fashion, in essays scattered through various periodicals, or in portions of books relating to other subjects. Mr Harting has collected together in the present volume his own essays in the *Field* and in the *Popular Science Review*, and has brought to bear upon his subject a knowledge of records, and an acquaintance with sport, which render his work extremely valuable His references are accurate, and he has availed himself of nearly every source of information Consequently we have before us a work dealing with the bear, wolf, beaver, reindeer, and "wild cattle," worthy to be classed between Bell's "British Quadrupeds" on the one hand, and White's "History of Selborne" on the other, relating not merely to the animals, but to the forests in which they lived and to the mode in which they were hunted.

The common brown bear made its appearance on the Continent in the Pleistocene age, and crossed over to Britain while the areas of the North Sea and of the English Channel were fertile valleys abounding in animal life Its remains occur both in the river-deposits and in the caves, and have been met with in the turbaries and alluvia of England and of Scotland, which belong to the prehistoric period. It was hunted by the Neolithic inhabitants of Britain, and used for food by the inhabitants of Colchester and Richmond in Roman times From the "Penitentiale" of Archbishop Egbert (A D 750), in which the flesh of any animal torn by dog, wolf, fox, or bear, or any other wild animal is forbidden to be used for human food, it is clear that it was alive in this country at that time In the days of Edward the Confessor Norwich furnished annually one bear to the king and six dogs for the baiting of it. This however does not prove the existence of wild bears in Britain at that date, because bear-baiting was almost a national sport among the English until bears became too costly and the public taste too refined for such brutal exhibitions Fitz-Stephen tells us, in the reign of Henry II, that the young Londoners amused themselves in the forenoon of every holiday in the winter

season with boar-fights, or bull- and bear-baiting. A grand exhibition of bear-baiting took place at Hatfield House when Queen Mary visited her sister, the Princess Elizabeth, during her confinement there, "with which their Highnesses were right well content" Soon after the ascension of the latter to the throne she entertained the Spanish ambassadors with bulls and bears, and some years afterwards she received the Danish ambassador at Greenwich, and entertained him with bear-baiting. "tempered with other merry disports" On one occasion at Kenilworth no less than thirteen bears were baited before the queen with large ban-dogs. From these notices it is evident that Queen Elizabeth was very fond of this sport Some of the great nobles and ecclesiastics also kept bears and bear-wards Latterly there were travelling bear-wards dependent upon their patrons The bear was probably extinct in Britain about the time of the Norman Conquest, and is not known to have existed in Ireland within the historic period.

The wolf abounded in Britain in the Pleistocene and prehistoric periods, and varied in numbers in the historic age in proportion to the waste lands It was a subject of many legal enactments, and grants of land were held for its capture To the numerous references which Mr Harting gives we may add an extract from the Litany of Dunkeld current in Scotland in the eleventh or twelfth century "A caterants et latronibus, a lupis et omni mala bestia, Domine, libera nos."

The animal had a price set upon its head by statute in 1621, the price paid for one wolf in Sutherlandshire was six pounds, thirteen shillings, and fourpence In Ireland, in 1683, "for every bitch wolfe the price was six pounds, for every dog wolfe five pounds, for every cubb which preyeth for himself forty shillings, and for every suckling cubb ten shillings" It is obvious from these large prices that the wolf was becoming rare in Scotland and Ireland in the middle of the seventeenth century The last of the British wolves was killed in Scotland in 1743 by MacQueen, a man remarkable for his stature and courage, who died in the year 1797. The memory of the exploit is still preserved by tradition In Ireland the animal lingered until 1770 Mr Harting deserves great credit for having collected together the evidence by which these dates can be fixed The wolf became extinct in England in the reign of Henry VII

The wild boar still lingered in Lancashire in 1617, and the last notice of the animal in the south of England is of the hunting of the wild boar at Windsor by James I and his court. Mr Harting considers that an entry in an account book of the steward of the manor of Chartley "1683 —February Pd. the cooper for a paile for ye wild swine, 0 2 0," proves that it was not extinct in England at that date It seems however to us very unlikely that wild boars would have such attention paid to their wants, and more probable that they were domestic swine turned out into the woodlands to get the greater part of their own living.

The reindeer, so abundant in the late Pleistocene age, and so generally found along with Palæolithic implements, and so strangely associated with the remains of hippopotamus in the hyæna-dens of this country (a fact which proves the two animals to have been contemporaneous), was rare in the prehistoric period, and disappeared altogether from its last foothold in Caithness about the latter half of the thirteenth century. We may remark that the recent attempts to introduce the animal into Switzerland have failed, apparently from the great heat of summer.

The beaver was living in the River Teivi, according to Girald du Barry, in 1159, and, according to Boethius, was taken in Lochness for the sake of its fur towards the end of the fifteenth century We would call the attention of our readers to the remarkably interesting account of its reintroduction by the Marquis into the Island of Bute, where they are now increasing rapidly and building their dams. There is evidently no difficulty in naturalising them in this country

We close this review regretting that it is impossible to do justice to the careful account of the different breeds of the "wild white cattle," which we believe to be the descendants of the domestic cattle introduced by the English, and which have always lived in uninclosed lands W. BOYD DAWKINS

OUR BOOK SHELF

Notes of Observations of Injurious Insects Report, 1880 By Eleanor A Ormerod 8vo pp 1-48 (London W Swan Sonnenschein and Allen. Edinburgh J. Menzies, 1881)

MISS ORMEROD and her assistants are to be congratulated on this very excellent Report, which is far more bulky than its predecessors, and correspondingly useful and interesting, and well illustrated. At the outset a very significant fact is mentioned The season of 1880 was remarkably suitable for vegetation, and the attacks of insects consequently less severe; a high condition of vitality enabled the plants to more successfully cope with their insect enemies The most injurious species for the year was the well-known larva of *Tipula* (daddy-long-legs), which not only attacked its more usual food, the roots of grasses, but proved itself extremely injurious to peas, so that in one field of twenty acres the prospective value in March was reduced to a realised value of only about one half in June; other crops were also attacked Stimulating remedies, such as guano, salt, ammoniacal liquor, &c, had a good effect, but the grubs appeared to be remarkably indifferent to ordinary poisonous solutions. An experiment at the Kew Observatory as to the amount of cold they can endure showed that some survived 42° of frost. Another very injurious species was *Tephritis onopordinis* (the celery-fly), a dressing of gas-lime, unslaked lime, and soot had a good effect The singularly misnamed *Psila rosæ* (the carrot fly) was also obnoxious; sowing the seeds in a mixture of leaf-mould, ashes, &c, proved of excellent service in this case. *Sitones lineatus* was very injurious to peas We think Miss Ormerod acts injudiciously in calling this insect the "pea-weevil" Its larva is certainly very much given to attacking peas and many other plants, by eating the young shoots, but the true pea-weevil is *Bruchus pisi*, which destroys the peas themselves by feeding inside them. For the gooseberry saw-fly nothing proved so effectual as digging out the earth round the bushes when the larvæ and pupæ are underground, the removed portion being taken away and burnt; a suggestion that if pieces of woollen cloth be placed on the bushes the parent fly will deposit her eggs thereon seems far-fetched. Miss Ormerod has great faith in the efficacy of paraffine. In future it is proposed to extend the Report to insects not hitherto specially mentioned as desirable for observation, such as the larch-aphis and pine saw-fly. We are glad to note that the authoress has a Manual of Economic Entomology in the press.

Mémoires de la Société des Sciences Physiques et Naturelles de Bordeaux 2e série, tome iv, 1er cahier (Paris: Gauthier-Villars, 1880.)

THIS number contains Conférences de Géométrie supérieure by M. Saltel, in which is given an exposition of the method of analytical correspondence with two applications, the object of the one being to find the number of common solutions in k equations between k unknowns, and of the other to find the degree of a geometrical locus defined by certain algebraic conditions. The methods employed are based on that of M. Chasles's "Principe de Correspondance." The next paper, by M. Imchenetsky, "Détermination en fonction des coordonnées de la force qui fait mouvoir un point matériel sur une section conique," is an interesting one, and is founded upon a remark of M. Bertrand's ("Sur la possibilité de déduire d'une seule des lois de Kepler, le principe de l'attraction, *Comptes rendus*, April 2, 1877), "il serait intéressant de résoudre la question suivante: En sachant que les planètes décrivent des sections coniques, et sans rien supposer de plus, trouver l'expression des composantes de la force qui les sollicite en fonction des coordonnées de son point d'application." The author arrives at his result by taking his equation in the form—

$$px^2 + qy^2 + 2rxy = (ax + by + c)^2.$$

Prof. Teixeira of Coimbra has a short note "Sur les principes du calcul infinitésimal," which calls for no special comment. Dr. G. Sous follows with what appears to us a good article entitled "Phakomètre et Optomètre." For the uninitiated "Les phakomètres sont des instruments destinés à mésurer la distance focale d'une lentille quelconque." The principle of construction of Silbermann's and of Snellen's is, when an object is placed at twice the focal distance from a converging lens, the real image of the same size as the object is situated also at double the focal distance from the lens. The objection to Silbermann's appears to be its length, which renders it awkward to carry, and to Snellen's that it is not applicable to diverging lenses.

Dr. Sous gives a form which is not liable to either of these defects, and the construction of which is based upon a physical theory, not hitherto, he states, applied to these instruments; but we must refer those interested in optics to the paper itself (fourteen pages in length). The rest of the book is devoted to "Morphologie de la membrane de Schrapnell," Dr. Coyne; "Études d'Optique Physiologique: Influence du Diamètre de la Pupille et des Cercles de Diffusion sur l'acuité visuelle," Dr. Badal; "Les Températures de la Mer dans l'estuaire Girondin et à Arcachon en décembre, 1879, et janvier, 1880," M. Hautreux; "Des Os et de leur Emploi dans la Fabrication du noir Animal, du Suif, du Sulfate d'ammoniaque, des Boutons," &c., M. Huyard.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Aberration of Instinct

CASES of individual variations of instinct are of importance in relation to Mr. Darwin's theory of the development of instincts by natural selection. Under the belief that aberration of instinct may be regarded as a case, more or less extreme, of variation, I think that the following instance is worth publishing in NATURE. It has been communicated to me by a correspondent on whose trustworthiness I have reason to rely:—

"A white fantail pigeon lived with his family in a pigeon-house in our stable yard. He and his wife had been brought originally from Sussex, and had lived, respected and admired, to see their children of the third generation, when he suddenly became the victim of the infatuation I am about to describe. . . .

"No eccentricity whatever was remarked in his conduct until one day I chanced to pick up somewhere in the garden a ginger-beer bottle of the ordinary brown stone description. I flung it into the yard, where it fell immediately below the pigeon house. That instant down flew paterfamilias, and to my no small astonishment commenced a series of genuflexions, evidently doing homage to the bottle. He strutted round and round it, bowing and scraping and cooing and performing the most ludicrous antics I ever beheld on the part of an enamoured pigeon. . . . Nor did he cease these performances until we removed the bottle; what proved that this singular aberration of instinct had become a fixed delusion was this, whenever the bottle was thrown or placed in the yard—no matter whether it lay horizontally or was placed upright—the same ridiculous scene was enacted; at that moment the pigeon came flying down with quite as great alacrity as when his peas were thrown out for his dinner, to continue his antics as long as the bottle remained there. Sometimes this would go on for hours, the other members of his family treating his movements with the most contemptuous indifference, and taking no notice whatever of the bottle. At last it became the regular amusement with which we entertained our visitors, to see this erratic pigeon making love to the interesting object of his affections, and it was an entertainment which never failed, throughout that summer at least. Before next summer came round he was no more."

GEORGE J. ROMANES

Prehistoric Europe

A FEW last words with Prof. Dawkins, and I have done:—

1. Having discovered that a certain absurd opinion which he attributed to me is nowhere to be met with in the volume he was supposed to be criticising, Mr. Dawkins now imagines that he has found grounds for his assertion in my "Great Ice Age," written and published some years ago. Here again he is quite mistaken. The passage cited by him, even if it be considered apart from its context, will not bear the interpretation he puts upon it. Had he read the page he quotes from with intelligent attention he would have seen that I was referring to the well-known fact that the ossiferous and Palæolithic gravels of East Anglia are represented in the North by the equivalent ossiferous *Cyrena* beds near Hull, which dovetail with and are overlapped by glacial deposits. In other words, they rest upon a *lower*, and are covered by an *upper* boulder clay. But I have nowhere said, nor would any candid reader infer from what I have written, that this upper boulder-clay (that of Hessle) ever extended south so as to cover the Palæolithic gravels throughout East Anglia. I am surprised that a professor of geology does not apparently understand the meaning of the term "overlap." Were I to state that in certain districts in Scotland the Carboniferous strata are overlapped by a conformable series of Red Sandstones, should I be understood to imply that these Red Sandstones formerly covered the entire area now occupied by the Carboniferous rocks of Great Britain?

2. Mr. Dawkins has accused me of having suppressed evidence which told against my views, and he now repeats this offensive accusation, citing in justification my description of the Victoria Cave, from which, he says, I have omitted all reference to the discovery of reindeer in the lower cave earth. Now it is not true that I have ignored this alleged discovery, for I remark that "it seems doubtful whether the remains of that animal, said to have been obtained from the lower earth, really belonged to that deposit." My reasons for this doubt (which I share with other geologists) I did not consider it necessary to give, but they are simply these:—

(1) The explorations in the cave were carried on at first, under Mr. Dawkins's superintendence, by means of shaft-digging, a very unsatisfactory system of "cave hunting," and one which, even with the most conscientious care, is liable to give false results.

(2) During the subsequent prolonged and scientifically-conducted explorations no recognisable reindeer remains were ever obtained in the lower stratum. These facts alone are sufficient to justify my scepticism. I quite agree with Mr. Dawkins, however, that the mere occurrence or non-occurrence in this particular cave of reindeer associated with hippopotamus is not of paramount importance. Even the most inattentive reader of "Prehistoric Europe" can hardly miss the statement, again and again repeated, that the southern and northern forms are often

enough commingled in one and the same accumulation. It is to account for this remarkable commingling that a large portion of my book was written.

3. Mr. Dawkins seems to be ignorant of the fact that the ossiferous deposits of Mont Perrier occur on two separate and distinct horizons. The *lower* bed, characterised by the presence of *Mastodon arvernensis* and other extinct forms, is unquestionably true Pliocene. It is overlaid by the "pumiceous conglomerate," with its far-transported and glacially-striated erratics. Upon the denuded surface of this well-marked morainic accumulation rests the *upper* bed, which contains a very different mammalian fauna—*Elephas meridionalis*, *Rhinoceros leptorhinus* (Cuv.), hippopotamus, tapir, horse, cave-bear, hyæna, hedgehog, &c. The flora associated with this fauna is not Pliocene but Pleistocene. The upper bed is overlaid in turn by a newer set of glacial moraines and erratics. The list of Upper Pliocene Mammalia from Mont Perrier and Issoire, given by Mr. Dawkins in his "Early Man in Britain," consists of a "hash-up" of the species derived from those two separate and distinct horizons.

4. The most recent list of mammalia from the lignite-beds of Leffe and Borlezza is quoted by me from Prof. Stopanni, on the authority of Dr. Forsyth Major. All the species in that list, without exception, have frequently occurred in Pleistocene beds, the age of which is generally admitted. The plants and shells associated with these species are all likewise Pleistocene forms. Moreover, as Stopanni has demonstrated, and as I can testify, the stratigraphical evidence proves that the beds pertain to the Glacial series. Prof. Mayer, no mean authority, has shown that the upper beds of the so called Pliocene of the Val d'Arno (containing *Elephas meridionalis* and hippopotamus) are not the equivalents of the marine Pliocene, as has hitherto been the belief of palæontologists, but must be classified as Quaternary or Pleistocene.

5. All that I say with regard to the age of the skull of Olmo occurs on p. 318 of my book, and what I say is simply this, "It pertains to Pleistocene times—to the period during which *Elephas meridionalis* belonged to the European fauna." I do not assert its Interglacial age. It may be either Preglacial (*i.e.* early Pleistocene) or Interglacial as the Leffe beds are.

I was not aware that geological classification is always based on zoology alone. I am under the impression that botanical evidence, when it can be obtained, is not despised, and that stratigraphical and other physical evidence is not usually ignored. In trying to work out the historical geology of the Pleistocene, I have considered the palæontological as fully as the physical evidence. Mr. Dawkins would have me rest contented with that of the mammalia alone, as interpreted by himself.

Perth, February 19 JAMES GEIKIE

As my name has been imported into the controversy between Prof. Dawkins and Dr. James Geikie, will you kindly permit me to state that I am quite prepared, after re reading the account given by Dr. Geikie of the Victoria Cave, to accept all responsibility for its correctness.

Without entering into the general question, in the particular case of the Victoria Cave the evidence for the contemporaneity in the same area of the reindeer and hippopotamus is not very cogent; a review of all the evidence from that source indeed points the other way. The specimen mentioned by Prof. Dawkins was, according to his Report,[1] found in digging a shaft, a method of exploration unfortunately at that time (1872) employed by the Committee. The subsequent explorations, which were not conducted in this manner, but by carefully removing the deposits, layer by layer, to prevent any possibility of accidental mixture of the remains, gave abundant evidence of reindeer in the upper beds, but not any satisfactory evidence of its presence in the lower beds, containing *Hippopotamus*, *Elephas antiquus*, *Rhinoceros leptorhinus*, &c. This is a point, amongst others, to which, as Reporter to the Committee, I paid careful attention, and the details were impartially given in the Reports.[2] The absence of reindeer from a lower bed, the only one containing the same fauna in the Creswell caves explored by the Rev. M. Mello and Prof. Dawkins, is worthy of note as bearing on the same subject.

As regards the evidence for the antiquity of man from the Victoria Cave, Dr. Geikie has fairly stated both sides of the question, and he certainly does not deserve the accusation that he "has only called those witnesses which count on his side." Prof. Dawkins, in dismissing the whole of this evidence as "founded on a mistake," must be aware that he is using a convenient formula which can only apply fairly to a part of it, the doubtfulness of which has already been fully conceded. He entirely shelves other evidences which are the result of a long and careful exploration.[1]

To state that he doubts their cogency would be to take a course of which no one would complain, but to say as if it were a matter of general agreement that they are "founded on a mistake," looks like an attempt to stifle discussion.

But his remarks are so obviously polemical that to most geologists they will probably carry more amusement and less conviction than the writer contemplated.

Hastings, February 19 R. H. TIDDEMAN

[1] Report on the Victoria Cave, British Assoc. Report, 1872, Sections, p. 179.

[2] Victoria Cave, British Assoc. Reports, 1874–78.

[1] Victoria Cave Report, *op. cit.* 1877, pp. 218-220, and 1878, *Journ. Anthrop. Inst.* vol. vii. pp. 166-173.

Les lettres d'Outre-mer

IN the Notes, published in NATURE of January 13, p. 254, the last paragraph gives, as a fact, an announcement of "the simplest post-office in the world" in Magellan Straits, as still in existence.

At least fourteen years ago there was published a graphic account of this unique establishment by the most eminent of all living French writers, M. Victor Hugo, who introduces the circumstance into his famous work of fiction, "Les Travailleurs de la Mer", and ever since reading the account I have wondered where the great author obtained his circumstantial relation, which refers to the year 1823. Nor can I believe that such a system of oceanic exchange ever really was in existence, at least on the spot indicated, for a very good reason, that at the point indicated, viz. the neighbourhood of Port Famine, when the *Beagle* was there in 1834 (see Darwin's "Naturalist's Voyage," chap. xi.), "the Fuegians twice came and plagued" the crew; so that an open barrel would hardly be safe. Darwin, also, who ascended Mount Tarn, the most elevated point in this district, would surely have mentioned this famous barrel post-office, had it existed (?)

I am therefore curious to know whence the note in NATURE was compiled, but I fancy the account is apocryphal. That there were however other oceanic post-offices somewhat similar in principle is a fact in reality.

In 1673 Ascension was visited by the Dominican, Father Navarette, who speaks of it then as the "*Sailor's Post-Office.*" "Mariners of all nations being accustomed at that time to leave letters here, sealed up in a bottle, in a certain known cranny of some rock, to be taken away by the first ship which passed in an opposite direction" (Mrs. Gill's "Six Months in Ascension," p. 61). And again in 1769 we find the following extract:—

"1769, *Febry.* 3-4.

"Ascension island.

Bougainville.

Louis de Bougainville, Colonel of Foot and Commodore of the Expedition in the Frigate *La Boudeuse*.

Arrd. and anchored in the North-west creek or '*Creek of the Mountain of the Cross*'.

Anchorage according to Abbé la Caille

7° 54′ S.—16° 19′ west, of Paris.

Variation 9° 45′ NW.

Three creeks caught turtle.

N.E. creek. N.W. creek. English creek, S.W.

"In the afternoon the bottle was brought to me which contains the paper whereon the ships of every nation generally write their name, when they touch at Ascension Island.

"This bottle is deposited in a cavity of the rocks of this bay, where it is equally sheltered from rain and the spray of the sea. In it I found written the *Swallow*, that English ship which Captain Carteret commanded, and which I was desirous of joining.[2] He arrived here the 31st of January, and set sail again on the 1st of February, thus we had already gained six days upon him, after leaving the Cape of Good Hope. I inscribed the *Boudeuse* and sent back the bottle."

At page 4 of Melliss' "Account of St. Helena (1875) is a wood-cut of the South Atlantic Post Office of 1645. Speaking of the island of St. Helena, Mr. Melliss says:—

"It became about this time—little more than a century after its discovery—a resort of Dutch and Spanish ships, as well as

[2] *La Boudeuse* caught up the *Swallow*, 25th February.

English, and Portuguese authority seems to have been lessened, through that Power being interested in acquiring possessions elsewhere, and the island was for a while deserted, though still used by the captains and crews of ships as a South Atlantic post-office It was customary to place letters under huge boulders of stone, marked in a conspicuous manner, so that the crews of ships returning from India might obtain news from home. An interesting record of this period is still to be seen on a rude block of lava measuring nearly five feet high and two feet six inches wide, which has been preserved by being subsequently built into a large mass of masonry in the Jamestown burial-ground."

In the Galapagos Islands there is a bay named Post-Office Bay, which seems to indicate an analogous nautical exchange station.

I subjoin Victor Hugo's description, and shall be much obliged to any of your readers who can refer me to any account of the earlier voyagers whence this scene was derived

S. P. OLIVER

2, Eastern Villas, Anglesey, Gosport, February 28

P.S.—If any one can give me a reference, also, where I can find an account of the wreck of the *Grosvenor* on the south east coast of Africa in 1782, I shall be extremely obliged.

"*Les Travailleurs de la Mer*, édition illustrée (1866). Livre cinquième, IX.

—Renseignement utile aux personnes qui attendent, ou craignent, des lettres d'outre-mer" (p. 91).

"Ne disiez-vous pas, Capitaine Gertrais que la *Tamaulipas* ne relâchera point?

—Non Il va droit au Chili

—En ce cas il ne pourra pas donner de ses nouvelles en route.

—Pardon, Capitaine Clubin. D'abord il peut remettre des dépêches à tous les bâtiments qu'il rencontre faisant voile pour Europe.

—C'est juste

—Ensuite il a *la boite aux lettres de la mer*

—Qu'appelez-vous la boite aux lettres de la mer?

—Vous ne connaissez pas ça, Capitaine Clubin?

—Non

—Quand on passe le detroit de Magellan

—Eh bien?

—Partout de la neige, toujours gros temps, de vilains mauvais vents, une mer de quatre sous

—Après?

—Quand vous avez doublé le cap Monmouth.

—Bien. Ensuite?

—Ensuite vous doublez le cap Valentin.

—Et ensuite?

—Ensuite vous doublez le cap Isidore [1]

—Et puis?

—Vous doublez la pointe Anna.[1]

—Bon. Mais qu'est ce que vouz appelez la boite aux lettres de la mer?

—Nous y sommes. Montagnes à droite, montagnes à gauche Des pingouins partout, des pétrels tempêtes. Un endroit terrible Ah! mille saintes mille singes! Quel bataclan, et comme ça tape! La bourrasque n'a pas besoin qu'on aille á son secours. C'est là qu'on surveille la lisse de hourdi! C'est là qu'on diminue la toile! C'est là qu'on te vous remplace la grande voile par le foc, et le foc par le tourmentin! Coups de vent sur coups de vent. Et puis quelque-fois quatre, cinq, six jours de cape sèche. Souvent d'un jeu de voiles tout neuf il vous reste de la charpie. Quelle danse! des rafales à vous faire sauter un trois-mâts comme une puce. J'ai vu sur un brick anglais, le '*True Blue*,' un petit mousse occupé à la '*gibboom*' emporté à tous les cinq cent mille millions de tonnerres de Dieu et la '*gibboom*' avec. On va en l'air comme des papillons, quoi! J'ai eu le contre-maître de la *Revenue*, une jolie goelette, arraché de dessus le *fore-crosstree*, et tué roide. J'ai eu ma lisse cassee, et mon serre-gouttière en capilotade. On sort de là avec toutes ses voiles mangées. Des frégates de cinquante font eau comme des paniers. Et la mauvaise diablesse de côte! Rien de plus bourru. Des rochers déchiquetés comme par enfantillage On approche du Port-Famine Là c'est pire que pire. Les plus rudes lames que j'ai vues de ma vie. Des parages d'enfer Tout à coup on aperçoit ces deux mots écrits en rouge. POST OFFICE

—Que voulez-vous dire, Capitaine Gertrais?

—Je vous dire, Capitaine Clubin, que toute de suite après qu'on a doublé la pointe Anna on voit sur un caillou de cent pieds de haut un grand bâton. C'est un poteau qui a une barrique au cou. Cette barrique, c'est la boîte au lettres. Il a fallu que les anglais écrivent dessus POST OFFICE. De quoi se mêlent ils? C'est la poste de l'océan, elle n'appartient pas à cet honorable gentleman, le roi d'Angleterre Cette boîte aux lettres est commune. Elle appartient à tous les pavillons POST OFFICE, est-ce assez chinois? Ça vous fait l'effet d'une tasse de thé que le diable vous offrirait tout à coup. Voici maintenant comment se fait le service. Tout bâtiment qui passe expédie au poteau un canot avec ses dépêches. Le navire qui vient de l'Atlantique envoie ses lettres pour l'Europe, et le navire qui vient du Pacifique envoie ses lettres pour l'Amérique. L'officier commandant votre canot met dans le baril votre paquet et y prend le paquet qu'il y trouve Vous vous chargez de ces lettres-la; le navire qui viendra après vous se chargera des vôtres Comme on navigue en sens contraire, le continent d'ou vous venez, c'est celui ou je vais Je porte vos lettres, vous portez les miennes Le baril est bitté au poteau avec une chaîne Et il pleut! Et il neige! Et il grêle! Une fichue mer! Les satanicles volent de tous côtés Le *Tamaulipas* ira par là Le baril a un bon couvercle à charnière, mais pas de serrure ni de cadenas Vous voyez qu'on peut écrire à ses amis Les lettres parviennent.

—C'est très-drôle, murmura Clubin rêveur."

[1] Sta. Anna Pt. is at entrance of Port Famine, but Cape S Isidro is past to the south.

Explosive Gas in a Lake

A FRIEND, on whom I can rely, informs me that during the late frost, Loch Ken in Kirkcudbrightshire was frozen over, affording pastime to curlers and skaters Here and there, however, small spots of the surface, near to the shore, resisted the frost longer, and when they did freeze the ice was very thin These pot-holes were dangerous to skaters, the largest being about size enough to admit an ordinary curling stone. Gas was emitted from them, and when the ice for the first time was formed over them one person got his face severely burned by boring a small hole in the thin ice and setting fire to the gas thus liberated, with a match After a while the gas seemed to lose its power of combustion and the experiment could be repeated with impunity, a feeble flame only being evoked, when the hole was first drilled

J. SHAW

Dumfriesshire, March 4

Colours of British Butterflies

THE sober colouring of the under-wings of many of our butterflies is universally accepted as being "protective" Let the gorgeous "peacock," for instance, but close his wings, and it takes a sharp eye to see him. Why then should he and so many other kinds flaunt their most brilliant hues in the brightest sunshine, and often be rendered even more conspicuous by perching on a yellow flower? One would think that this was the exact way to attract birds, especially as the colours are not likely to be "warning" ones, for if so, why the sober hues of the under sides of the wings? The colours can hardly be "warnings" to particular kinds of birds and "protective" against the attacks of others. The explanation may be that the facilities for recognition, and thus for the continuation of the species, are so much greater in bright light, as to render it advantageous on the whole to run the chance of easier capture in the brighter parts of the day or it may be that relatively few birds feed at the times that butterflies choose to display their beauties.

In watching butterflies it appears clear that they are, so to speak, shortsighted, for it is the commonest thing p ssible t see two entirely different sorts circle round each other for some time as if they had to decide whether they are of the same kind or not In doing this it will be observed that they fly, as it were, over and over each other, so that for quite half the time the gambols are going on, the dark side of the "protected" kinds is shown to the insect below. Here steps in a provision which seems admirably adapted for enabling recognition to take place. It will be found that though the wings of protectively coloured butterflies appear very dark at a casual glance, yet that if they are held up to the light, in many cases there are bright spots or colourings or semi transparent spaces, that, by enabling the sun to shine through, make even the dark wings very conspicuous. The bright spots on the "peacock" are a case in point. I have not an opportunity of actually handling a complete collection of our British butterflies just now, but in thirty of our commonest sorts I find fifteen that have distinctly protectively

coloured under-wings Of these fifteen all have some more or less transparent spaces or colourings. In some cases portions of the under-wings are brightly coloured, though not transparent, but both in this case and when there are transparent places they appear chiefly on parts that are apparently invisible when the wings are closed If these observations are correct, the insects are carefully protected when at rest or when they are laying their eggs. Whether they pair on the ground or with shut wings I do not actually know, for after carefully watching every butterfly I have come across for two summers, I have not succeeded in seeing any of the protectively coloured sorts pairing It seems likely enough therefore that their protective colours come into play then My opportunities for observation are however extremely limited, and it is to draw the attention of those more favourably situated to the subject of the colours of our common butterflies that I write this. In the fifteen protectively-coloured butterflies mentioned above I did not include the "fritillaries," because of the strange metallic lustre on their under-wings. Still they seem suddenly to disappear when they settle, and the metallic spots may take the place of the transparent or coloured ones in other sorts by throwing off the light, and thus enable the insects to recognise each other. Eight kinds more or less transparent but not seemingly protectively coloured, and two common "Blues," make up the thirty kinds I have been able to handle The under-wings of the "Blues" are certainly protectively coloured, but there seems to be no transparency or bright markings in them J INNES ROGERS

Putney, February 24

Dust, Fogs, and Smoke

THE present endeavours to alleviate the smoke nuisance in London give some interest to the description of the effects of coal smoke on London life in former ages

I do not mean to speak of the well-known petition presented to Edward the First by the nobility and gentry against the use of sea-coal in London and the consequent proclamation of that monarch interdicting its use But I allude to the following lines written and published by Evelyn in 1661 in his "Fumifugium," but which I borrow from the "History of London," by Noorthouck, London, 1773

"The immoderate use of, and indulgence to sea coale alone in the city of London, exposes it to one of the fowlest inconveniences and reproaches, that can possibly befall so noble, and otherwise incomparable city · and that, not from the culinary fires, which for being weak and lesse often fed below, is with such ease dispelled and scattered above, as it is hardly at all discernible, but from some few particular tunnells and issues, belonging only to brewers, diers, lime burners, salt, and sope-boylers, and some other private trades one of whose spiracles alone, does manifestly infect the aer, more than all the chimnies of London put together besides And that this is not the least hyperbolie, let the best of judges decide it, which I take to be our senses whilst these are belching it forth their sooty jaws, the city of London resembles the face rather of Mount Ætna, the court of Vulcan, Stromboli, or the suburbs of hell, than an assembly of rational creatures, and the imperial seat of our incomparable monarch. For when in all other places the aer is most serene and pure, it is here ecclipsed with such a cloud of sulphure, as the sun itself, which gives day to all the world besides, is hardly able to penetrate and impart it here, and the weary traveller, at many miles distance, sooner smells, than sees the city to which he repairs This is that pernicious smoake which sullyes all her glory, superinducing a sooty crust, or furr upon all that it lights, spoyling the moveables, tarnishing the plate, gildings, and furniture, and corrodding the very iron bars and hardest stones with those piercing and acrimonious spirits which accompany its sulphure; and executing more in one year than exposed to the pure aer of the country it could effect in some hundreds It is this horrid smoake which obscures our churches and makes our palaces look old, which fouls our clothes, and corrupts the waters, so as the very rain and refreshing dews which fall in the several seasons precipitate this impure vapour, which with its black and tenacious quality, spots and contaminates whatever is exposed to it. It is this which scatters and strews about those black and smutty atomes upon all things where it comes, insinuating itself into our very secret cabinets, and most precious repositories · finally, it is this which diffuses and spreads a yellownesse upon our choysest pictures and hangings; which does this mischief at home, is Avernus to fowl, and kills our bees and flowers abroad, suffering nothing in our gardens to bud, display themselves or ripen; so as our anemonies and many other choycest flowers will by no industry be made to blow [sic] in London, or the precincts of it, unlesse they be raised on a hot-bed and governed with extraordinary artifice to accellerate their springing, imparting a bitter and ungrateful tast to those few wretched fruits, which never arriving to their desired maturity seem, like the apples of Sodome, to fall even to dust when they are but touched. Not therefore to be forgotten is that which was by many observed, that in the year 1644 when Newcastle was besieged and blocked up in our late wars, so as through the great dearth and scarcity of coales, those fumous works many of them were either left off, or spent but few coales in comparison to what they now use, divers gardens and orchards, planted even in the very heart of London (as in particular my lord Marquesse of Hertford's in the Strand, my lord Bridgewater's and some others about Barbican), were observed to bear such plentiful and infinite quantities of fruits, as they never produced the like either before or since to their great astonishment but it was by the owners rightly imputed to the penury of coales and the little smoake, which they took notice to infest them that year, for there is a virtue in the aer to penetrate, alter, nourish, yea and to multiply plants and fruits, without which no vegetable could possibly thrive."

The improvement mentioned by Evelyn, when the use of coal was for a time less extensive in London, is particularly worthy of notice, and ought, I think, to be considered as an encouragement to persist in the attempt of rendering London as smokeless as possible CHATEL

Jersey, February 25

THE GERMAN CHEMICAL SOCIETY

ON November 11, 1867, a meeting of about eighty chemists was held in Berlin to take steps for inaugurating a new Chemical Society. On January 13 of the succeeding year (1868) the first meeting of the Society was held, when Prof A. W Hofmann was elected president, and the roll-call of the Society contained 105 names. During the first year of its existence 97 papers were read before the Society, at the close of the year the membership had increased to 275, and the Society found that a volume of 282 pages was needed to contain the papers communicated to it.

Since 1868 the German Chemical Society has steadily increased in size and in usefulness, the *Berichte* for 1880 consists of two large volumes numbering, between them, 2473 pages, and containing the 563 papers communicated to the Society during the year, besides numerous abstracts of papers published elsewhere. The income of the Society for 1880 amounted in round numbers to the sum of 2000*l*, and of this about 1400*l*. was set against the cost of publishing the *Berichte*

During the thirteen years of its existence the German Chemical Society has published in its *Berichte* most of the important discoveries in pure chemistry made in that period. It has been the aim of the Society to publish papers communicated to it with as little delay as possible. Meetings are held twice monthly during the session, and the papers read at one meeting are published in the *Berichte*, which appears on the day on which the next meeting takes place. Papers appearing within so short a time after they are communicated are necessarily brief and concise; but this rapid publication confers a great benefit on all chemists, as they are thus put in possession of at least the leading facts concerning all recent work almost as soon as these facts have been established by the workers If papers in the *Berichte* are sometimes wanting in completeness and symmetry, many of them are full of life and stir, telling as they do of work actually proceeding in the laboratory; appearing sometimes in short abrupt snatches, they convey something of the enthusiasm of the worker as he compels nature, bit by bit, to yield her treasured secrets.

The system of printing abstracts of papers published in the various chemical journals has recently been adopted

by the Society; formerly a correspondent in London or Paris, &c, sent a general account of chemical work published in the country from which he wrote. The abstracts of the German Society are on the whole shorter than those which have for many years made the *Journal* of our own Chemical Society of such great value to the student; they are, however, published at a shorter interval after the appearance of the original paper.

Brief accounts are given of recent chemical patents, but little space is devoted to purely technical chemistry. Is not the *Journal* of the Chemical Society sometimes overburdened by abstracts which might better find a place in a book professing to collect receipts for the purely "practical man"?

The German Chemical Society in 1877 appointed Dr. C. Bischof of Berlin to prepare a general index for the first ten volumes of the *Berichte*. The arduous task has been admirably fulfilled. Fellows of the Society have now in their hands not only an index to the *Berichte*, but a volume which is really a general guide to the chemical work published during the period 1868–1877.

The "Generalregister" extends to 1020 pp., of these, 162 pp. are devoted to an index of authors, 732 pp. to an index of subjects, 42 pp. to an index of patents, and 84 pp. to a systematic classification of the carbon compounds referred to in the index.

Under an author's name are given, not the exact title of his paper, but a very succinct statement of the leading points in the paper. The same method is pursued in the subjects-index. Taking, for instance, such a general subject as "Dissociation," one finds, first, references to work on the general Theory of Dissociation, *e.g.* connection between dissociation and temperature, tension, &c., then follow special instances of dissociation, inorganic compounds preceding organic. In the case of individual elements or compounds, the references begin with those papers on the existence of the substance in question, then follow its preparation and formation, its properties, its action on other substances, the action of other bodies on it, its estimation, &c., &c.

A systematic nomenclature is adopted, more especially for the carbon compounds, the principles which guided the compiler are stated in a few introductory pages.

The "Generalregister" cannot but be of the greatest value to chemists generally. Almost every chemist is a Fellow of the German Society, many possess the *Berichte* complete up to date; with the *Berichte* and this admirable guide which Dr. Bischof has supplied, they can find almost everything that has been done in experimental chemistry within the period 1868–1877. M. M. P. M.

IRISH ESPARTO GRASS

It is now over two years ago since attention was called in our pages to the importance of the purple Molinia (*Molinia cærulea*) as a material for making paper. Mr. Christie of Edinburgh sent a small quantity of it to be operated on by Mr. T. Routledge of Sunderland, and the report on this was most favourable. In January, 1879, a notice appeared in the *Times* also calling attention to the subject, and referring to the above favourable report, it expressed the hope that some effort would be used to have this grass collected on an extensive scale. It would seem to be ripe for gathering in the early autumn, when some hands could be spared for such work, and as the ground on which it flourishes—wet or partially drained bogs—pays, at least in Ireland, little if any rent, the crop would cost little over the expense of reaping it. Since the first notice appeared in our columns, the Spanish and African Esparto grass has been getting more difficult to obtain, and the demand for it has been steadily on the increase. It is said that the greater part of what is gathered in Morocco finds its way to the *Times* paper-mills, and its value for paper-making is now known in America. Several analyses of specimens of the dried hay made from this grass are given in a paper by Dr. Cameron, "On the Composition of a Crop of Hay" (*Proc.* Roy. Dub. Soc., n.s., vol. ii. p. 101), we select one of these, which yielded as follows:—

100 parts contained—

Water	27·95
Albuminoids	7·49
Fats	2·70
Non-nitrogenous substances	30·00
Woody fibre	31·26
Mineral water	0·60
	100·00

And of this the ash contained—

Lime	28·86
Magnesia	4·76
Potash and soda	42·17
Phosphoric acid	12·36
Sulphuric acid	5·98
Oxide of iron and alumina	1·00
Chlorine	4·32
Silica	0·55
	100·00

This freedom from silica of the purple Melic grass is very remarkable.

From a paper by Mr. W. Smith in the recent number of the *Proceedings* of the Royal Dublin Society, we learn that a very successful trial has been made in the county of Galway to grow this grass in some quantity. As a native plant it is found in every county in Ireland, both on wet heaths and boggy pastures. It flowers in July and August, and its seeds are ripe early in September; it would seem to grow well on partially drained bogs, and if the surface of these has been burnt, the purple Melic grass grows thereon most luxuriantly. It seems fond of growing in tufts, of somewhat large size, and it does not form a sod like so many other grasses. It would appear that in Ireland alone there are over 1,000,000 acres at the present moment not worth sixpence a year each for any agricultural purpose, each acre would easily grow half a ton weight of dried Melic grass, which at its lowest value would be worth 2*l.* Would not this crop, in time, more than compensate for the loss of the potatoe? It seems a pity that the manufacturer should have to go to the Port of Mogador for what he might get with so much greater ease at the Port of Dublin.

SIBERIAN METEOROLOGY

Up to the present time Yakutsk, in North-east Siberia, has often been cited as the place of our earth where the winter is coldest, while the minima observed during Arctic expeditions are believed to be the lowest known. Neither the one nor the other is true. In Maak's book, "Olekminski Okrug," I find many data which prove that the coldest winter as well as the lowest well-authenticated minima were observed at Werkhojansk, to the north-east of Yakutsk. The name of the author gives us some guarantee that the observations are trustworthy. I give below the minima at some places cited by Maak, and compare them with those observed in Central and Western Siberia, and the Arctic Archipelago of America:—

North-East Siberia				
Serdze-Kamen.	67° N.	173° E.	(Nordenskjold)	− 50·3 F.
Yakutsk	62° N.	130° E.	(Maak)	− 77·3 F.
Wiljuisk	64° N.	122° E.	(Maak)	− 76·3 F.
Werkhojansk.	67½° N.	134° E.	(Maak)	− 81·0 F.
Central and West Siberia				
Yenisseisk	58½° N.	92° E.		− 73·5 F.
Barnaul	53½° N.	84° E.		− 61·4 F.

Arctic Archipelago

British Expeditions, 1875-76.	83½° N.	Floeberg Reach (Nares)	− 73·7 F.
	81¾° N.	Discovery Bay (Nares)	− 70·7 F.

The temperature at Werkhojansk is the lowest of all given here, and it must be borne in mind that the observations lasted but one year, while we have more than thirty-five years at Yakutsk, and eight and a half at Yenisseisk.

The mean temperatures are as follows :—

	Year	July	Nov	Dec	Jan	Feb	March
Serdze Kamen 1 yr	—	—	2·1	− 9·0	−13·1	−13·2	− 6·9
Ustjansk 2 years	2·8	5·7	− 2·2	−33·0	−38·9	−36·9	−17·5
Werkhojansk 1 year	4·3	60·1	−29·2	−46·8	−55·5	−54·5	−29·0
Yakutsk 10 years[1]	12·2	66·5	−20·5	−41·9	−46·8	−37·7	− 0·0
Yakutsk 24 years[2]	12·4	67·3	−19·1	−37·6	−41·4	−30·8	− 8·7
Floeberg Beach 1 yr	− 3·5	38·3	−16·8	−22·2	−33·0	−38·0	−39·8
Discovery Bay 1 yr	− 4·2	37·2	−18·4	−24·5	−40·7	−35·0	−37·4

Though the observations were made only during one year at Werkhojansk, it is probable that it would have the coldest winter of all observed till now, as even at Yakutsk, which is the next coldest, January and February were in no single year colder than at Werkhojansk in 1869. From a comparison with the other stations of North-east Siberia it is probable that here in 1869 February was too cold and December too warm.

Now as to the reason why the winter should be colder in North-east Siberia than on the North American Archipelago farther to the north, it is to be found in the extent of the continent, the distance from any sea open in winter, and the prevailing calms. How important is the last reason is best seen by the comparison of the December and January temperatures of the last British expedition. The more northerly Floeberg Beach is warmer, because more exposed to winds. Now in Eastern Siberia calms prevail to a large extent in winter, except near the coast.

There is a phenomenon to be considered, which is noticed everywhere in winter in high latitudes during calms with clear sky the valleys are colder than the surrounding hills and slopes, because the cold air sinks downwards and stagnates there. This is confined to the night where the mid-day sun rises high enough, but in high latitudes during some months the mid-day heat of the sun is too small and the day too short to interfere much with the equilibrium of the strata of air established during the night. Even in middle latitudes (45°–50°), when calms and clear weather prevail very largely in December, the valleys are regularly colder than the hills. So it was felt in December, 1879, in Central Europe. What is an exception here is the rule in North-East Siberia, because calms and clear sky are the rule in winter; the valleys are much colder than the hills. On this account the exceedingly low temperature of Werkhojansk in winter is probably not common to the whole surrounding country, and especially in the mountains rising to a short distance south we may expect a much higher temperature. The more we consider the conditions of the winter temperature of North-East Siberia, the more difficult it seems to draw isotherms. We know that plains and valleys there are colder than hills and mountain-slopes, but how much, and what conditions are most favourable to that so-called interversion of temperature? I consider it as highly probable that both at Yakutsk and at Werkhojansk the local topographical conditions are very favourable to winter cold. This being the case, it is quite natural that the latter place is colder in winter than the former, being situated 5° farther to the north, and yet far enough from the west to have a continental climate.

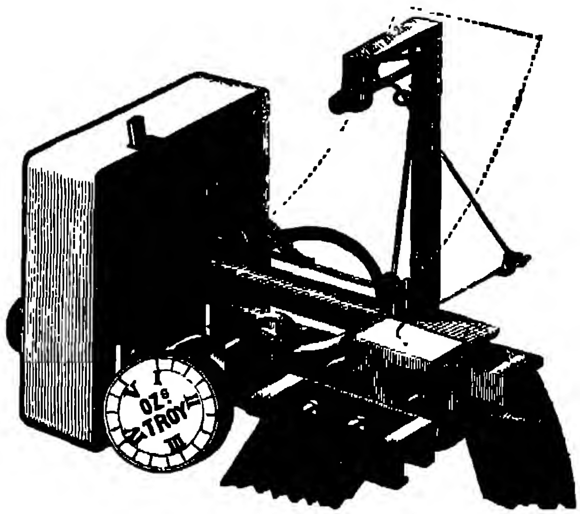
A. WOEIKOF

[1] According to Maak.
[2] Older series of Neverof (1830-54).

SPHYGMOGRAPHY

THE pulse has in all ages been held by physicians to be a valuable aid to the diagnosis of disease, but until the invention of the sphygmograph, or pulse-writer, the determination of the character of the pulse was left to the tutored tact of the doctor's finger, which varies much in delicacy of perception in different operators, and in the same practitioner at different times. At most the finger, even of the most experienced, can only detect, regarding the pulse, that it is soft or hard, quick or slow, jerky or languid, regular or irregular, but the finger is incapable of analysing the beats, and detecting any departure from the normal standard of each of their component elements. The sphygmograph, which is quite a modern invention, causes the pulse to write its own autograph, enables us to see at a glance the peculiar characters of the pulse, and to ascertain how and where it differs from the healthy or normal pulse.

Hitherto, however, the sphygmograph has been but little used, for those that have been introduced are large and expensive instruments, requiring a great amount of skill and trouble to fix them on the arm and bring them into action; and for these reasons they are not available for general or private practice. Hence their use has almost been confined to hospital practice, but even here



they are not always available, for Dr. B. Bramwell, who is a strong advocate for employing the sphygmograph, relates that a patient of his was so terrified by the proposal to employ the instrument that he preferred leaving the hospital to allowing it to be fixed on his arm.

The objections to the general use of the sphygmograph do not apply to the instrument recently introduced into medical practice by Dr. Dudgeon, and from its portability called "the pocket sphygmograph." Though this instrument is so small as to deserve the name of "pocket," it is not inferior in sensitiveness to the most elaborate and complicated of the cumbrous instruments hitherto in use, indeed in some respects it is greatly superior in accuracy to any that have yet appeared. Its size is 2½ by 2 inches; its weight only four ounces. It magnifies the movements of the artery exactly fifty times. The spring that presses on the artery can be regulated to press with a weight of from one to five ounces, and the pressure can be altered at will while the instrument is *in situ*. It requires no wrist-rest; all the other sphygmographs have to be used with wrist-rests of more or less complexity. It can be used with equal facility whether the patient is standing, sitting, or lying. With it an accurate and extremely distinct tracing of the pulse can be made almost as quickly as the pulse can be felt with the finger. Its

construction is so simple that if accidentally broken any watchmaker can repair it. The smoked paper on which the pulse is recorded runs through the instrument in ten seconds, so that the number of the beats per minute can be reckoned by multiplying the pulse-tracings on the paper by six. The patient's name, the date, the disease, the pressure of the spring, and some conventional sign to indicate his position when the tracing was made, may be written on the marked paper with any sharp-pointed instrument, such as a pin or a toothpick, and the whole permanently fixed by dipping the paper in some quickly-drying varnish, such as is used by photographers. In this way a series of pulse-tracings taken during the course of the disease may be preserved for future study and comparison.

Dr Dudgeon's pocket sphygmograph is manufactured by Mr. John Ganter, 19, Crawford Street, W. The woodcut represents its actual size

NOTES

WE understand that the fifth volume of the Catalogue of Birds in the British Museum will shortly be published According to the classification followed in this work the families to be described will be the Thrushes and Warblers, and the volume will be written by Mr Henry Seebohm, whose co-operation Dr. Gunther has been fortunate in obtaining Mr Seebohm has devoted a close study of several years to these families of birds, and may now be considered the best living authority on the subject

M. FLAMMARION, the author of several works in popular astronomy, has been made a Knight of the Légion d'Honneur Admiral Mouchez, director of the Paris Observatory, has consented to act as his *parrain*, and to hand over to him the star and ribbon. This liberal determination has created some sensation in the French astronomical world. The work of transformation of the Observatory will begin very shortly, all the legal difficulties having been solved The area of the establishment is now 30,000 square metres The magnetical instruments will be placed in the deep trenches separating the old ground from the newly annexed buildings

WE regret to have to announce the death of M. Eugène Cortambert, author of a number of geographical works, honorary president of the Geographical Society of Paris, and head of the geographical department in the National Library.

ABOUT a year ago Admiral Mouchez asked for a credit of 4000 francs per year in order to publish a monthly astronomical review M Jules Ferry refused the grant, but a similar review is now being published at Brussels under the name *Ciel et Terre* It appears twice a month, and is devoted to meteorology and astronomy.

ALTHOUGH our Government has declared the interest which it takes in the forthcoming International Exhibition of Electricity at Paris, still it sees no necessity for appointing a Special Commissioner to take measures with regard to the participation of British subjects in the Exhibition which is to open in Paris on August 1 next in the Champs Elysées Palace. The French Government is nevertheless disposed to welcome all British subjects wishing to participate in the Exhibition. M. Berger, the Commissaire-Général, has placed himself unreservedly at the disposal of intending exhibitors to afford every information and assistance. He would be thankful if they would fill up and return to his address the printed form of demand of admission which accompanies the copy of the general regulations. English exhibitors will be placed in every respect on the same footing as French exhibitors. M Berger will form a special section for the group of English exhibitors, and requests that all demands be forwarded within the briefest delay possible. The Exhibition rooms and dependencies will be considered as real Custom-house stores, so that all the articles sent there shall be exempt from the duties to which they would otherwise have been liable. The French railway companies have consented to an abatement of 50 per cent. on the ordinary rates of transport, whether by fast or by slow trains, for all packages or boxes forwarded to the Exhibition Hall, and bearing the official labels The Postmaster-General has been authorised by the British Government to exhibit in the name of the latter.

A COMMITTEE has been formed at Dijon for erecting a statue to Carnot, the celebrated French geometer and politician, who was born in Nolay, a small country town of Burgundy, in 1753. The youngest son of Carnot is now living, one of the members of Senate, and his grandson is M. Sadi Carnot, the present Minister of Public Works. The other son of Carnot died fifty years ago, after having written a small essay, "Sur la Puissance motive du feu." M Carnot's brother has just published a new edition of this work, with a number of essays, mostly unpublished, by the same author, and a history of his life

AT the conclusion of the proceedings of the Quekett Microscopical Club on February 25 occasion was taken to present to Mr. J E Ingpen a memorial of the esteem in which he is held and the appreciation of his services as honorary secretary for the last eight years After an able address by Dr Matthews, setting forth the reasons which had led to this movement on the part of the members, and short speeches by Dr Cobbold, Mr Crisp, and Mr Michael, Mr T C White handed to Mr Ingpen a beautifully illuminated and framed memorial, together with a valuable microscope by Zeiss and a handsome silver tea service, which were accepted and acknowledged amidst hearty demonstrations of good feeling on the part of the meeting. The attendance of members was unusually large, and in the course of the evening telegrams were received from Dr. M C. Cooke and Mr Henry Lee, expressing their regret at unavoidable absence

AT the ordinary meeting of the Meteorological Society, to be held at 25 Great George Street, Westminster, on Wednesday, the 16th inst., at 7 p.m., there will be an exhibition of instruments, consisting of various kinds of hygrometers and of such new instruments as have been brought out since January 1, 1880 During the evening the President will give a historical sketch of the different classes of hygrometers, and will also describe such forms as are exhibited

THE town of Casamicciola, in the Island of Ischia, has been almost entirely destroyed by an earthquake More than 200 houses have been thrown down, and many others are so much damaged as to be uninhabitable The number of persons thus far ascertained to have been killed is 104, and very many more have been injured The total number of victims is estimated at 300 This dreadful catastrophe was the result of two shocks—the first at half-past one in the afternoon of the 4th inst., lasting seven seconds; the second after an interval of an hour and a half The whole upper part of the town has been destroyed The handsome Albergo della Grande Sentinella is a mass of ruins. Clefts and fissures opened in the streets 50 centimetres in width. It was at first supposed that this disaster was connected with the partial eruption of Vesuvius on the 3rd inst, but Prof Palmieri has stated that the seismographic instruments having given no indications, he is inclined to think the catastrophe is due to some local phenomenon, possibly to a sudden sinking of the ground through subterranean corrosion caused by the continual working of the mineral waters. Shortly before the first shock of earthquake the mineral springs were observed to be in a state of ebullition. Another shock was felt at midnight.

SHOCKS of earthquake occurred at St. Ivan-Zelina (Hungary) on February 26 at 3h 54m., in the night of February 26 27 at

12h. 30m., and on February 27 at 5h. 28m. a.m. At Agram a rather severe shock was felt on February 25 at 3h. 45m., duration two seconds, direction west-south-west, and another at noon of March 4. Earthquakes are also reported from Kirchberg (Austria), on February 28, at 2h. 20m. a.m., duration two seconds, and from different parts of Switzerland on March 3, e.g. Zurich and its environs, at 3h 35m. a.m., Aussersiehl, at 3h. 42m., direction west to east, duration two seconds, Riesbach, Selnau, Knonau, Aaran, Zofingen, Hunzenschwyl, Rapperschwyl, Glarus, Zug, Berne. The earthquake shock felt at Berne on Thursday morning last shortly after three o'clock was a very smart one. The area of disturbance was wide, extending as far as the Lakes of Geneva and Bienne.

MR. H. J. JOHNSON-LAVIS writes to us from Naples, under date March 2:—Vesuvius has to-day been covered with snow, and this evening, during a short interval between the mantling of clouds, a splendid stream of lava is pouring down the northern side and has reached the Atrio del Cavallo. The stream is very liquid and very abundant, and from this it may be concluded that its course will be progressive.

M. JULES FERRY has established a number of colleges for females in several parts of France; some of them have been already opened.

THE authorities of the British Museum will very soon issue their scheme for publishing the great catalogue of printed books. The projected issue, at the rate of five volumes a year, is not expected to be completed in less than forty years. The work, however, can of course proceed no faster than the Government grant of 1600*l*. a year for this special purpose will permit. Altogether the catalogue is likely to comprise about 3,000,000 titles, which to put in type will cost from 4*d*. to 6*d* each. It has already been announced that the publication will commence with volumes specially devoted to certain subjects, or rather sub-headings, which have now become too voluminous for convenient handling in their present form. Meanwhile the Trustees have adopted the plan of printing and publishing the titles of all additions to the library. It may be interesting to know that in this case all titles are stereotyped on separate "plaques," and are therefore susceptible of any amount of re-arrangement.

AN important experiment in electric lighting is about to be made in the City. Hitherto the electric light has been used, as on the Thames Embankment and Waterloo Bridge, in conjunction with gas, but in the City the thoroughfares selected are to be lighted by electricity alone, which will be continued all night. The first district begins with Blackfriars Bridge, and extends along Bridge Street, Ludgate Hill, the north side of St Paul's Churchyard, and down Cheapside as far as King Street. The distance is 1648 yards, and is to be lighted by the Brush system. At King Street the Siemens system will begin, and will extend along the rest of Cheapside, the Poultry, Mansion House Street, King William Street, and Adelaide Place, and across London Bridge. The same system will be extended down King Street, Queen Street, and Mansion House Street. The whole length of street covered by the Siemens light will be 1521 yards. Another district to the south of these will be lighted by the Jablochkoff lamps, like the Embankment. It will include Southwark Bridge, Queen Victoria Street, Queen Street Place, and part of Queen Street, a distance of 1703 yards. The experiment is to be continued for a year, at an outlay of about 8000*l*.

PROF BLACKIE being unable to lecture through illness, Mr. Shelford Bidwell, M.A., LL.B., will give a discourse on Selenium and its Applications to the Photophone and Telephotography, at the Royal Institution, on Friday evening next (March 11), at 9 p.m.

THE Calendar of the Mason Science College, Birmingham, is a volume of respectable size, but then it contains a full report of proceedings and addresses at the opening meeting. We are glad to see that a large number of new chairs are about to be added, including Greek, Latin, and modern languages; so that the College will shortly be as well equipped as that at Manchester. As the curriculum is being extended to include really literature, science, and art, might it not be well to drop the "science" from its designation? it looks so one-sided.

THE *Proceedings* of the last Congress of Russian Naturalists, which was held at St. Petersburg, have just appeared as a separate bulky volume.

A PAPER has been published by Gustav Hauser of Erlangen, on the organs of smell in insects, in which he describes several experiments. Numerous species of insects, on approaching vessels containing turpentine or acetic acid, showed—by retreating and moving their antennæ—a distinct perception of the smell. After the ends of the antennæ had been cut off, the same insects placed close to the vessels appeared quite insensible to it. A number of flies, which had been attracted by a piece of putrid meat, showed no inclination to approach it after the third segment of the antennæ had been cut off.

WE have received a pleasant report of the Queenwood College Mutual Improvement Society for the year ending Christmas, 1880. The Society seems to have a comprehensive programme.

UNDER the title of the *Northern Microscopist*, and under the editorship of George E. Davis, a monthly periodical has been started, beginning with January of this year, the chief aim of which is to keep a record of the proceedings of the chief microscopical societies in the North of England, and thereby to furnish each individual member of these societies with as much permanent information as such members would obtain if the society to which they belonged published its own Transactions. There ought to be abundant support for a little journal like this, and numerous subscribers ought to be obtained from large centres like Liverpool, Leeds, Chester, Bolton, Manchester, Nottingham, Newcastle-on-Tyne, and the like. If the various Northern societies were to do nothing more than prepare local lists of all the varied species of animal and vegetable life, which come under the well-known denomination of "microscopical forms," and if this journal were to be the medium of publishing these, it would become a journal of importance, one that would be constantly referred to, and it would in the meantime be doing a good work in advancing the study of the biological sciences. We wish it every success, and trust that it will steadily pursue the path that it has marked out for itself.

A STENOGRAPHIC piano has been experimented on by the daughter of the inventor, in the French Chamber of Deputies, the Senate, and to the Municipal Council of Paris, with great success. The system consists of a combination of signs through which every sound is represented. The reproduction is as rapid as speaking, and the same operator can continue the work for hours. The signs used in this system being printed by machinery, the reading is immediate, and can be made by other people than the operator. The State stenographers propose to be trained in the use of the instrument. It is an affair of a few months of practice.

A SCIENTIFIC society has been formed at Scarborough, called "Scarborough Scientific Society and Field Naturalists' Club." President elect, Mr. J. Woodall, M.A.; Secretary, Mr. G. Massee.

THE excavations in the 9th region of Pompeii are being prosecuted with alacrity, and yield unexpected results. Besides a second mosaic fountain and valuable frescoes recently found,

there were excavated the other day some vases of Egyptian manufacture, which will greatly interest archæologists. They are made of a particular kind of paste, composed of white clay and glass, and are extremely brittle. All round they have high relief representations of the animals worshipped by the ancient Egyptians

A PHONOGRAPH of a new construction will be tried in the New Polyglot Institute of Paris, for the purpose of teaching pupils the art of pronouncing correctly the difficult words of foreign languages.

A SCHOOL for clockmakers has been organised in Paris, and was inaugurated yesterday by a meeting at the Conservatoire des Arts et Métiers.

THE new part of the *Transactions* of the Asiatic Society of Japan contains a paper by Dr. Edkins on the influence of Chinese dialects on the Japanese pronunciation of the Chinese part of the Japanese language

WE have received part 3 of the *Transactions* of the Epping Forest Club, containing the address of the president, Mr Meldola, proceedings, and list of members

WE have to acknowledge the receipt of a postal order for 2*s*. 6*d* from "Bullphumpus" for the John Duncan Fund.

THE additions to the Zoological Society's Gardens during the past week include an Indian Leopard (*Felis pardus*) from India, presented by the Duke of Buckingham and Chandos, an Entellus Monkey (*Semnopithecus entellus*) from India, a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, a Blue fronted Amazon (*Chrysotis festiva*) from Brazil, deposited, four Indian Rat Snakes (*Ptyas mucosa*) from India, a Matamata Terrapin (*Chelys matamata*) from Upper Amazons, purchased, two Calandra Larks (*Melanocorypha calandra*), European, a Chinese Quail (*Coturnix chinensis*) from China, two Fire-tailed Finches (*Erythrura prasina*) from Java, received from Paris.

OUR ASTRONOMICAL COLUMN

THE SOLAR PARALLAX.—M Faye has just communicated to the Academy of Sciences a paper on the actual state of our knowledge of the sun's parallax, of which we subjoin some particulars, without professing to regard his mean result as necessarily so definitive as he appears to view it himself.

M Faye considers that there is no other scientific constant, the determination of which depends on an equal number of results completely independent of one another, and obtained by methods so totally different, and subdivides the various values assigned for the sun's mean parallax as follows —

Geometrical methods, 8″ 82	8″85 by Mars (Cassini's method)	Newcomb
	8 79 by Venus, 1769 (Halley's method)	Powalky.
	8 81 by Venus, 1874 " "	Tupman.
	8 87 by Flora (Galle's method)	Galle
	8 79 by Juno " "	Lindsay.
Mechanical methods, 8″·83	8 81 by the lunar inequality (Laplace's method)	—
	8·85 by the monthly equation of the earth	Leverrier.
	8 83 by the perturbations of Venus and Mars	Leverrier
Physical methods, 8″·81	8·799 Velocity of light (Fizeau's method)	Cornu.
	8·813 Velocity of light (Foucault's method)	Michelson.

With regard to the first value by "mechanical methods," M. Faye mentions that he has obtained it by adopting for the coefficient of the inequality 125″·2, the mean between the results of Sir George Airy from the Greenwich observations, and that of Prof. Newcomb, from the observations made at Washington, taking for the moon's mean parallax, 57′ 2″·7, and for her mass $\frac{1}{80·8}$. Leverrier found the value 8″·95 from the said equation, which was reduced after correction by Mr. Stone for two small errors to 8″ 85. The value from the perturbations of Venus and Mars assigned by Leverrier was 8″·86, but one of the numbers requiring a small correction, it is reduced to 8″·83. Michelson, after bringing to bear upon Foucault's method improvements which M. Faye says completely surmounted all difficulties, found for the velocity of light 299940 km., while Helmert altered Cornu's result to 299990 km With Struve's constant of aberration the corresponding values for the solar parallax are 8″·799 and 8″ 813, as above.

The general mean in which it may be considered that the errors of the individual results, obtained by so many methods, are to a great extent compensated is 8″ 82, and to this value M. Faye, for reasons given, attributes a probable error of ± 0″·016. The mean value by the physical methods is 8″ 806, and by astronomical methods 8″ 825. He then considers which of these values is the more reliable, and states that he does not hesitate in giving the preference to the physical result, and arrives at the conclusions —

1. That the method of the physicists is superior to all others, and ought to be substituted

2 That the value of solar parallax, 8″ 813 (by physical methods), is now determined to about $\frac{1}{100}$ of a second.

3. That the seven astronomical methods of procedure converge more and more towards that value, and tend to confirm it without equalling it in precision.

M Faye adds that he has no idea of attempting to diminish the importance of the observation of the approaching transit of Venus but as Leverrier pointed out, "il faut que les efforts des astronomes aient pour but d'obtenir une précision toute nouvelle dans leur prochaines expéditions." Without neglecting the contacts, he considers it will be desirable to employ to a greater extent than was done in 1874 "les procédés si puissants de la photographie," to which, he it observed, M. Faye from his own experiences drew attention a quarter of a century back. He thinks it will be very surprising if that admirable method of procedure, which has already succeeded so well in measuring delicate stellar groups, should fail for the transit of Venus, or under circumstances more favourable for its application. The value 8″ 813 for the sun's parallax, which appears to him definitive, is in accordance with that adopted by Laplace in the *Mécanique céleste*, 27 2 centesimal seconds or 8″ 812

SWIFT'S COMET, 1880 *e*.—Mr. Winslow Upton of the Naval Observatory at Washington, sends us elements of this comet, which, as he remarks, afford a further confirmation of the 5½-years' period already assumed. He employed two observations made with the meridian circle of the Washington Observatory on October 25 and November 23, and one with the 26-inch equatorial on December 22 The elements are as follow —

Epoch 1880, October 25 5 M T. at Washington.

	° ′ ″	
Mean anomaly	357 48 49·3	
Perihelion from node	106 18 13·8	M. Eq. 1880·0
Ascending node	296 41 55·4	
Inclination	5 31 3·5	
Angle of eccentricity	42 31 39·7	
Log semi axis major	0·518438	

The corresponding period is 2189 days, or a little less than six years The middle place is represented within the small errors of − 1″ 2 in longitude and − 0″ 6 in latitude

PHYSICAL NOTES

MR. T C MENDENHALL of Japan has measured with a so-called "invariable pendulum" the acceleration of gravity at the top of the extinct volcano Fujiyama, which plays so prominent a part in the mythology and in the art of Japan. The value found for the summit of the mountain was g = 9·7886, whereas at Tokio the value was found to be 9·7984 The average barometric pressure at the summit was 19 5 inches, the mountain itself being an almost perfectly symmetrical cone of vertical angle 138°, and of a height of 2 35 miles It rises alone out of a plain of considerable extent, and appears to be composed of a uniform rock of porous nature. Tradition states that the mountain was thrown up in a single night in the year B C 286. The density of the rock in the lump was 1·75, but when reduced to powder the density was 2·5; competent geologists conclude the mean density of the mountain mass to be 2·12. Assuming the mountain to be a cone of semi-vertical angle of 69°, and density 2·12, Mr. Mendenhall calculated its attraction upon a particle

placed at the vertex, and comparing it with his result, deduced for the mean density of the earth the value $D = 5.77$. If however the accepted density of the earth as determined by Bailly at 5.67 be adopted, it follows that the mean density of Fujiyama is only 2.08.

A CAPITAL summary of the recent thermochemical investigations of Julius Thomsen appears in the current number of the *Am. Journ. Sci.* from the pen of Prof. Josiah P. Cooke (of Cambridge, Mass.). The peculiar significance of these researches in their bearing upon the problems of molecular structure in general and upon the supposed ring structure of the benzene molecule in particular, is pointed out in a clear and emphatic manner.

M. ROSENSTIEHL has freshly determined the tints corresponding to the three primary colour-sensations, on the principle of rotating disks originally devised by Clerk-Maxwell. Constructing a disk with seventy-two sectors of gradating tints of as nearly equal saturation as could be judged of by the eye, he found that a sensation of red more powerful than any single red tint could be compounded from blue, violet, red, orange, and orange-yellow, with a maximum intensity in the orange. Similarly a sensation of green more powerful than the brightest green tint, could be compounded out of a set of tints having a greenish-yellow for their maximum point, and the sensation of blue culminated in a tint named "third blue" by M. Rosenstiehl. Hence M. Rosenstiehl proposes to accept as the primary-sensation tints of the Young-Helmholtz theory the orange, the yellow green, and the ("third") blue tints, in which the three sensations of red, green, and blue find their respective maxima; further arguments on this point are promised shortly by M. Rosenstiehl.

ACCORDING to Wiedemann Swedish filter-paper, pyroxylised by steeping in mixed strong nitric and sulphuric acids, forms an excellent source for electricity by friction. Prof. Guthrie's films of collodion and gutta-percha, in five or six alternate layers, realise the same end, namely that of utilising for the generation of electricity the most powerfully *negative* electric known pyroxylin.

DURING a hailstorm in Geneva on January 19 Prof. Colladon observed the hailstones as they fell to repel each other mutually and to bound about after lying quiet for a moment or two on the ground exactly after the fashion of the pith balls in Newton's well-known experiment of the *electric hail*. The observation would appear to have a bearing on Volta's somewhat neglected theory of the formation of hail.

COMMANDER O. J. SHERMAN has taken some observations of deep-sea temperatures during the summer of 1880 on the Arctic steamer *Gulnare*, when becalmed at about lat. 61° N., long. 56° W., at a point where a branch of the warm Gulf Stream current is represented on the maps as being overlapped by an Arctic current whose direction is to the eastward coast of Greenland. The temperatures at the surface being in two observations respectively 41°.9 (F.) and 45°.0, those at the depth of sixty fathoms were found to be 39°.0 and 40°.0 respectively. At 150 fathoms a temperature of 38°.2 was observed, but at lower depths the temperature was again higher, reaching 40°.8 at 300 fathoms.

M. PAUL SÉGUY, whose experience as a constructor of vacuum-tubes is very great, gives the following results of observation upon the effect of cold upon the discharge through exhausted tubes. A tube cooled (naturally by being placed in a cold room) exhibits increased resistance, sometimes double its usual resistance, and may even require to be warmed at the fire or over a spirit-lamp to bring it to its usual working condition. But then the tube does not at once recover itself, but only gradually as the passage of the spark liberates heat and warms the glass and the electrodes. This experiment is best shown with a long thin tube and with a feeble induction-coil. With Crookes's high-vacua tubes the effects of heat are more pronounced, and can be readily observed by arranging a discharger in a branch circuit, the spark leaping between the poles of the discharger when the air-resistance is less than that of the tube. A cooled Crookes's tube does not transmit a spark equivalent to a 3-centimetre spark in air; but when warmed, the "radiant" effects appear to give place in turn to ordinary stratified discharges as the temperature rises. The inverse order of phenomena should take place on cooling, but does not if care has not been taken in the construction of the tube to expel residual occluded gases from the aluminium electrodes by heating them during the exhaustion. The effects of extreme artificial cold upon vacuum-tubes was not tried by M. Séguy. In conclusion M. Séguy asserts the existence of a curious phenomenon, namely, that in a tube used frequently and for a long time, the vacuum may grow more perfect, so as at last to be almost absolute. M. Séguy attributes this effect to the gradual occlusion by the electrodes of the residual gases.

IT has been proved by Herren Strouhal and Barus (*Wied. Ann.*, No. 13, 1880), from experiments in which steel wire was treated so as to show all degrees of hardness between the glass-hard and annealed states, that the thermo-electric and galvanic properties of steel vary with the degree of hardness in a very sensitive manner. Their researches throw some useful light on the nature of the annealing process and on the magnetic behaviour of steel in relation to its hardness and other properties.

HERR HOLTZ has been able (*Wied. Ann.*, 1, 1881) to measure the modulus of elasticity of rods of carbon used for the electric light (Carré's, of Paris) by the acoustical method; the rod being held in the middle with two fingers, and stroked lengthwise with two other fingers on which colophonium has been rubbed. The modulus increases with the density, which is, as a rule, greater in the thinner rods. The tone of thin rods alters a good deal, on repeated rubbing, through heat being generated. On an average the modulus is equal to that of lead. As to the proved increase of electric conductivity of carbon rods with rise of temperature, Siemens has tried to account for it by supposing allotropic modification (as is probably the case with selenium); Herr Holtz, however, shows that pyrolusite, a metallic oxide, behaves similarly, but such an explanation would not here apply. Nor does pyrolusite conduct as an electrolyte; there is no polarisation. For carbon Herr Holtz adheres to his hypothesis (of closer pressure of molecules caused by heat, improving the conduction), in default of a better.

A CENTIGRADE photometer devised by S. Coghevina is described in the *Rivista Sci. Ind.* for January 31. He seeks to remedy the imperfections of ordinary methods by substituting for a single source of light, defined by the substance of the combustible or its hourly consumption, a flame of variable size, which can be reduced to a particular degree of illuminating force. He means to apply the same principle to the electric and other light sources.

AN interesting phenomenon of polarisation of light was observed by Herr Sorrensen in the recent cold weather (*Naturf.*, No. 9). Some of the ice on a window-pane had melted, the water forming a small pool at the bottom. In this pool various bright and beautiful colours appeared; on looking closer they were seen to be only in the grotesque images of frost flowers on the lower part of the window, reflected in the water. The reflecting water surface was here the analyser, while the thin ice crystals, varying according to position and thickness in the ice flowers, played the part of polychromatic gypsum and mica plates. To find the polariser Herr Sorrensen took a Nicol prism, and observed that the daylight itself was strongly polarised, and this he accounts for by the presence of a light mist of ice particles reflecting the sunlight. The temperature outside was about − 12°.

WITH reference to the physical conditions of heavenly bodies Herr Lohse (*Wied. Ann.* 1) has experimentally studied the phenomena of glow on various metallic electrodes (magnesium, zinc, iron, cadmium, copper, &c.) in a hydrogen atmosphere of varying pressure. Quantitative data as to the relation of vapour formation to the density of the gas are furnished; and it is proved, *inter alia*, that with progressive rarefaction of hydrogen the luminous power of metallic vapours in the more refrangible parts of the spectrum increases (a sign of exalted temperature).

M. PELLAT gives, in the *Journal de Physique* (February), results of an inquiry into the apparent difference of potential of two metals in contact. This difference he finds to depend essentially on the nature of their superficial layer, and to vary (sometimes considerably) with chemical or simply physical changes of the surface. When an inert gas surrounding the metals is rarefied, the apparent difference of potential increases, and it recovers its former value on the pressure being restored. Further, the said difference has the same value as the electromotive force of a battery element formed by alcohol and the same metals (not yet altered).

DR. PULUJ has made the following experiment to prove his suggestion that radiant matter consists of electrode particles

pulled off by the action of electricity. The cathode of a vacuum-tube was covered with chalk. It exhibits phosphorescence of orange-yellow colour, while in a short time the tube-wall becomes covered by a very delicate layer of chalk, without losing its clearness and transparency, and phosphoresces like chalk. Puluj believes that the yellow-coloured phosphorescence observed on metallic cathodes is caused by the phosphorescence of the oxides covering the metal.

GEOGRAPHICAL NOTES

AT its annual meeting the Russian Geographical Society elected as vice-president M. Semenoff, and Baron Osten-Secken as his "aid." The great Constantine medals were awarded to M. Moushketoff, for his geological researches in Central Asia, and to M. Yanson, for his remarkable work on "Comparative Statistics of Russia," the two first volumes of which have already appeared, the Lutke gold medal was awarded to Baron Kaulbars for his papers on the Lowlands of the Amu-daria, the two great gold medals instituted last year for ethnographical and statistical researches were awarded to Dr. Pyasetzky for his work, "Travels to China during the Years 1875-77," and to M. Roussoff for his statistical description of the Nyejin district. Small gold medals were awarded to M. Nordkvist, who took part in Nordenskjold's expedition, to M. Potanin for his travels in Mongolia, to M Tyaghin, for meteorological observations on Novaya Zemlya, and to M Mainoff for anthropological explorations among the Mordovians. Silver medals were awarded to Mme. Treskina and to MM. Andrianoff, Unterberger, Polonsky, Orloff, Skassi, Karatin, Zinovieff, Krasovsky, and Mikhalenko.

WE learn from the last number of the *Izvestia* of the Russian Geographical Society that the Society sends this spring M Polyakoff with an assistant for the exploration of Sakhalin Island. M. Polyakoff will start from Odessa, on board of a Russian ship, and proceed to Sakhalin, where he will stay during a year, thence he will go to the Mantchurian shore of the Pacific for further explorations

THE explorer Begaert has arrived at Lisbon. He was sent by the King of the Belgians to make scientific researches on the route of Mr. Stanley at Vivi and other parts of Zaire

WE are glad to learn that the U.S Congress have decided to appropriate 175,000 dollars to send out an expedition in a whaling vessel in search of the missing steamer *Jeannette*, which was sent out in 1879 by Mr Gordon Bennett to carry on Arctic exploration by way of Behring Strait. The initiative in this matter is due to Chief-Justice Daly, President of the American Geographical Society.

IN addition to two papers descriptive of the visits of Mr. Leigh Smith to Franz-Josef Land and Mr. Delmar Morgan to Kuldja, the new number of the Geographical Society's *Proceedings* gives Mr. F C. Selous' notes on some of his many journeys in South Central Africa, those dealt with here being to the north of the Zambesi between the 27th and 29th meridians, and in the neighbourhood of the River Chobe which empties into the great river above the Victoria Falls We gave last week the text of the interesting note on Col. Prejevalsky, in addition to which we may refer to the record of some altitudes recently determined in Matabele Land, and a note of Dr Otto Finsch's explorations in Polynesia. The maps this month are of the South Coast of Franz-Josef Land and the Central Zambesi region.

WE observe that M. Henri Duveyrier's interesting observations on the question of the sources of the Niger appear in the last (December) number of the French Geographical Society's *Bulletin*, but we regret to find that they are published without a map.

IN last week's issue of *Les Missions Catholiques* Mgr Lavigerie, Archbishop of Algiers, commences an account of the missions of Equatorial Africa, with the direction of which he has been charged. There is also a letter from Père Antonin de Reschio in Brazil, in which will be found some notes on curious traditions among the Indians.

MARQUIS ANTINORI and the other members of the Italian expedition to Shoa are expected shortly at Zeila. It is also stated that Signor Libman, an Italian traveller, has gone to Assab in order to make an attempt to open commercial relations with the interior and to survey some of the little-known regions in the neighbourhood. Signor Giuletti, who accompanied the Italian official representative to Assab in January, is charged by the Italian Geographical Society to undertake a journey through the country of the Danakil and Adel tribes, and to study the best means for opening a trade-route between Assab and Abyssinia. His mission has considerable geographical importance, as the region to be traversed is unknown, and he will have an opportunity of solving the problem of the River Gualima, which probably he found to empty into some lake in the interior, as the Hanash does, if indeed it be not part of the latter river-system.

CAPT. NEVES FERREIRA, Governor of Benguela, and other Portuguese officers, have placed their services at the disposal of the Lisbon Geographical Society for a scientific expedition across Africa, to start from the West Coast.

THE *Sydney Morning Herald* of January 17 publishes a telegram from their Queensland correspondent as follows, dated January 14.—"Skuthorpe arrived two days ago from his exploring trip out west He reports having travelled 200 miles inside the South Australian boundary, and in the Herbert River discovered relics of Leichhardt, consisting of his diary and Classen's diary, also a telescope with presentation engraving, compasses, and other things. These, he alleges, are in two packs which he has brought with him. The diary of Classen is to the effect that he left Leichhardt at the Saltwater Creek while he searched for water, and that on his returning he found the party dead, and then joined the blacks, with whom he lived until three years ago. Skuthorpe will not allow any one to inspect the alleged relics, and here it is considered doubtful whether they are genuine."

INTELLIGENCE has been received at the Foreign Office from Her Majesty's Consul at Mozambique, which confirms the report of the deaths of Capt. Phipson Wybrants and Messrs Carr and Mears, of the Wybrants' expedition Mr Mayes is stated to be at Umzeilas, and Mr. Owen to have left with the remainder for Inhambane, whither Her Majesty's ship *Ruby* will proceed forthwith.

ON THE VISCOSITY OF GASES AT HIGH EXHAUSTIONS[1]

II.

INFLUENCE of Aqueous Vapour on the Viscosity of Air.—In the foregoing experiments many discrepancies were traced to the presence of moisture in the gas. The influence of aqueous vapour does not appear to be great when present in moderate amount in gas of normal density, but at high exhaustions it introduces errors which interfere with the uniformity of the results A series of experiments were accordingly undertaken to trace the special action of aqueous vapour when mixed with air.

Up to a pressure of about 350 millims. the presence of aqueous vapour has little or no influence on the viscosity of air. The two curves are in fact superimposed At this point, however, divergence commences, and the curve rapidly bends over, the viscosity falling from 0·0903 to 0·0500 between 50 and 7 millims. pressure. Here it joins the hydrogen curve, and between 7 millims and 1 millim. they appear to be identical.

These results are partly to be explained by the peculiar action of water vapour in the apparatus At the normal pressure the amount of aqueous vapour present in the air, supposing it to be saturated, is only about thirteen parts in a million, and the identity of the log dec. with that of dry air shows that this small quantity of water has no appreciable action on the viscosity. When the pump is set to work the air is gradually removed, whilst the aqueous vapour is kept supplied from the reservoir of liquid As the exhaustion approaches the tension of aqueous vapour, evaporation goes on at a greater rate, and the vapour displaces the air with increasing rapidity, until, after the pressure of 12·7 millims is passed, the aqueous vapour acts as a gas, and, being constantly supplied from the reservoir of water (as long as it lasts), washes out all the air from the apparatus, the log dec. rapidly sinking to that of pure water gas.

This explanation requires that the viscosity of pure aqueous vapour should be the same as that of hydrogen, at all events between 7 millims. and 1 millim. pressure. The facts can, however, be explained in another way During the action of the Sprengel pump sufficient electricity is sometimes generated to render the fall tubes luminous in the dark. It is conceivable

[1] Abstract of a paper read before the Royal Society, February 17, 1881. by William Crookes, F R S Continued from p 423.

that under such electrical influence the falling mercury may be able to decompose aqueous vapour at these high exhaustions, with formation of oxide of mercury and liberation of hydrogen. Of these two theories the latter appears to be the more probable.

The presence of water vapour shows itself likewise in the very slight amount of repulsion produced by radiation. Repulsion commences in air at a pressure of 12 millims., whilst at a higher exhaustion the maximum effect rises to over 40 divisions. Here, however, repulsion does not begin till the exhaustion is higher than the barometer gauge will indicate, whilst the maximum action after long-continued pumping is only 9 divisions.

Viscosity of Kerosoline Vapour.—The rapid diminution of viscosity in the last experiment after reaching the pressure of 400 millims., is probably due to the aqueous vapour in the air being near its liquefying point. It was thought advisable to test this hypothesis by employing a somewhat less easily condensible vapour, which could be introduced into the apparatus without any admixture of air. An experiment was accordingly tried with a very volatile hydrocarbon, commercially known as Kerosoline, boiling at a little above the ordinary temperature. The vapour of this body was introduced into the well-exhausted apparatus, when the gauge at once sank 82·5 millims. After the usual precautions to eliminate air a series of observations were taken.

The loss of viscosity is more rapid than with any other gas examined except aqueous vapour. Conversely a very great increase of viscosity occurs on increasing the pressure from 8 to 82·5 millims. The explanation of this is that the vapour of kerosoline is very near its liquefying point, and therefore very far from the state of a "perfect" gas.

The negative bend in the curve at about 10 millims. pressure, already noticed with other gases, is strongly marked with this hydrocarbon vapour.

Discussion of Results.—When discussing the viscosity results obtained with the different gases experimented with, the author gives the following approximate comparison of viscosities, such as is afforded by a comparison of the log decs. of each gas and that of air, comparing the ratio with that obtained by Graham, Kundt and Warburg, and Maxwell.

	Graham	Kundt & Warburg	Maxwell	Crookes.
Air	1·0000	1·0000	1·0000	1·0000
Oxygen	1·1099	—	—	1·1185
Nitrogen	0·971	—	—	0·9715
Carbonic oxide	0·971	—	—	0·9715
Carbonic anhydride	0·807	0·806	0·859	0·9201
Hydrogen	0·4855	0·488	0·5156	0·4439

Graham's numbers are the theoretical results deduced from his experiments on transpiration of gases. They are, he says,[1] the numbers to which the transpiration times of the gases approximate, and in which they have their limit. Graham concludes that the "times of oxygen, nitrogen, carbonic oxide, and air are directly as their densities, or equal *weights* of these gases pass in equal times. Hydrogen passes in half the time of nitrogen, or twice as rapidly for equal volumes. The result for carbonic acid appears at first anomalous. It is that the transpiration time of this gas is inversely proportional to its density when compared with oxygen."

The proportion between air and oxygen, nitrogen, or carbonic oxide is not very different at any degree of exhaustion to that which it is at 760 millims. Carbonic anhydride, however, is different, the proportion between it and air holds good between 760 and 650 millims. Then it gets lower and lower as the pressure sinks, until 50 or 55 millims is reached, when the proportion between it and air again becomes constant.

Hydrogen, however, is entirely different to the other gases; its log dec. remains the same to a very high exhaustion, and, that of other gases sinking, it is evident that the proportion between this gas and any other is different for each pressure.

It must not be forgotten that the pressure of 760 millims. is not one of the constants of Nature, but is a purely arbitrary one, selected for our own convenience when working near the level of the sea. In the diagrams accompanying his R S paper the author has started from this pressure of 760 millims., and has given the log dec. curves which approximately represent the viscosities through a wide range of exhaustion. But the curves might also be continued, working downwards instead of upwards. From the shape and direction in which they cut the 760 line, it is reasonable to infer their further progress downwards, and we may assume that an easily liquefiable gas will show a more rapid increase in viscosity than one which is difficult to liquefy by pressure. For instance, hydrogen, the least condensible of all gases, shows scarcely any tendency to increase in log dec by pressure. Oxygen and nitrogen, which are only a little less difficult to condense than hydrogen, show a slight increase in log dec. Carbonic anhydride, which liquefies at a pressure of 56 atmospheres at 15° C., increases so rapidly in log dec that at this pressure it would have a log dec. of about 1·3, representing an amount of resistance to motion that it is difficult to conceive anything of the nature of gas being capable of exerting.

[1] *Loc. cit.* pp. 178, 179.

Kerosoline vapour is rendered liquid by pressure much more readily than carbonic anhydride. Its curve shows a great increase in density for a very slight access of pressure.

Again, aqueous vapour is condensible to the liquid form with the greatest readiness; and the almost horizontal direction of the curve representing aqueous vapour mixed with air carries out the hypothesis.

It follows, then, that Maxwell's law holds good for perfect gases. The disturbing influence spoken of in the commencement of this paper as occasioning a variation from Maxwell's law, is the tendency to liquefaction, which prevents us from speaking of any gas as "perfect," and which hinders it from obeying Boyle and Mariotte's law. The nearer a gas obeys this law the more closely does it conform to Maxwell's law.

Maxwell's law was discovered as the consequence of a mathematical theory. It pre-supposes the existence of gas in a "perfect" state—a state practically unknown to physicists, although hydrogen gas very nearly approaches that state. An ordinary gas may be said to be bounded, as regards its physical state, on the one side by the sub-gaseous or liquid condition, and on the other side by the ultra-gaseous condition. A gas assumes the former state when condensed by pressure or cold, and it changes to the latter state when highly rarefied. Before actually assuming either of these states there is a kind of foreshadowing of change, with partial loss of gaseity. When the molecules, by pressure or cold, are made to approach each other more closely, they begin to enter the sphere of each other's attraction, and therefore the amount of pressure or cold necessary to produce a certain density is less than the theoretical amount by the internal attraction exerted on each other by the molecules. The nearer the gas approaches the point of liquefaction the greater is the attraction of one molecule to another, and the amount of pressure required to produce any given density will be proportionally less than that theoretically required by a "perfect" gas.

A noteworthy point in connection with the elasticity of glass is observed on the curves of viscosity. They are not continued beyond the 0·02 M exhaustion, but the general form of the curves indicates that, if they were produced beyond the limits of the observations, they would cut the line representing the absolute vacuum. The curve representing the repulsion accompanying radiation evidently goes up to the zero point, showing that at an absolute vacuum there would be no repulsion. The curves of viscosity cannot, however, be supposed to end at the zero point without a sudden change in direction. They evidently touch the top line of zero pressure long before the log dec. of 0·00 is reached. This means that in an absolute vacuum there would still be a measurable amount of viscosity. This is probably due to the viscosity of the glass torsion fibre, for it has been ascertained that glass is not perfectly elastic, but will take a permanent *set* if kept under constraint for a considerable time.

The author gives an instance which has come under his own notice. In 1862 he purchased a piece of glass lace, and some spun glass from which the lace was made. The spun glass is in long straight threads, about 0·001 inch diameter, and has occasionally been used for torsion fibres. The fibres of which the lace was made were originally straight, but the twists and bends in which they have been kept for eighteen years have permanently altered their direction, and on dissecting a portion of the lace the component fibres remain distorted and bent, even when free to resume their original shape.

Were glass perfectly elastic the log dec. in an absolute vacuum would probably be equal to *zero*: there would then be no diminution in the arc of vibration, and the torsion fibre once set swinging would go on for ever.

The Ultra-Gaseous State of Matter.—A consideration of the curves of viscosity of the gases, especially hydrogen, which are

given in the foregoing pages, confirms the supposition that a gas, as the exhaustions become extreme, gradually loses its gaseous characteristics, and passes to what the author has ventured to call an ultra-gaseous state Certainly it ceases to possess many of the properties usually held to be the essential attributes of gaseity.

For instance, Maxwell's law that the viscosity of a gas is independent of pressure holds good to a certain point, and then it rapidly breaks down. All gases appear to obey Maxwell's law between some limits of exhaustion, and diverge from it at others. Thus the nearly perfect gas hydrogen shows signs of increasing in viscosity as the pressure approaches 760 millims, and it is very improbable that its viscosity would remain the same if the pressure were to be considerably increased. Between 5 and 35 millims. the respective viscosities of carbonic anhydride, carbonic oxide, nitrogen, oxygen, and air scarcely vary at all, showing that between these limits they are practically as "perfect" gases as hydrogen is throughout the whole barometric range from 760 millims. to 1 millim, and here therefore they obey Maxwell's law as perfectly as hydrogen does The change to the ultra-gaseous state commences to be assumed at about an exhaustion of half a millim. In hydrogen the change then proceeds slowly, but in the less perfect gases experimented with, the change to ultra gas takes place with greater rapidity.

In gases, variation of pressure in different parts of a closed vessel equalises itself with great rapidity, but in the ultra-gaseous state differences of pressure may exist for twenty minutes or more in different parts of the apparatus

In gases, electrically charged bodies do not permanently retain their charge, but gradually discharge themselves In ultra-gas, however, a pair of electrified gold leaves have remained repelled at absolutely the same angle for thirteen months.[1]

Another property of gases is that of facilitating the cooling of bodies immersed in them, by communicating an increase of motion to the molecules of the gas which carry it to the walls of the containing vessel,—*i.e* by *carriage* instead of *convection*. There is little difference in the rate of cooling with increased exhaustion, so long as we work with such ordinary good vacua as can be obtained by air-pumps For if, on the one hand, there are fewer molecules impinging on the warm body (which is averse to the carriage of heat), yet, on the other hand, the mean length of path between collisions is increased so that the augmented motion is carried farther, the number of steps by which the temperature passes from the warmer to the cooler body is diminished, but the value of each step is correspondingly increased. Hence the difference of velocity before and after impact may make up for the diminution in the number of molecules impinging

In gases, therefore, the rate of cooling is little affected by rarefaction, the law in this case being analogous to that governing the viscosity

In a paper which the author has recently read before the Royal Society,[2] he shows that when the exhaustion is carried to so high a point that the mean free path is comparable with the diameter of the containing vessel, the rate at which heat is conveyed across is much diminished. The molecules are now in the ultra-gaseous state, and further exhaustion produces a notable fall in the rate of cooling, an increase of exhaustion from 20 M to 2 M retarding the carriage of heat more than all the previous exhaustion from 760 millims. to 20 M.

The author has shown elsewhere[3] that the property of gaseity is pre-eminently a property dependent on collisions A given space full of air at the ordinary pressure contains millions of millions of molecules rapidly moving in all directions, each molecule momentarily encountering millions of other molecules in a second. In such a case the length of the mean free path of the molecules is exceedingly small compared with the dimensions of the containing vessel, and those properties are observed which constitute the ordinary gaseous state of matter—properties which depend upon constant collisions.

The gaseous state continues so long as the collisions are almost infinite in number, and of inconceivable irregularity. But in such high vacua as are now described the free path of the molecules is made so long that the hits in a given time may be disregarded in comparison to the misses, and the average molecule is allowed to obey its own motions or laws without interference; and when the mean free path is comparable to the dimensions of the containing vessel, the properties which constitute gaseity are reduced to a minimum, and the matter then becomes exalted to an ultra-gaseous state

In the ultra-gaseous state properties of matter which exist even in the gaseous state are shown *directly*, whereas in the state of gas they are only shown *indirectly*, by viscosity and so forth

The ordinary laws of gases are a simplification of the effects arising from the properties of matter in the ultra-gaseous state; such a simplification is only permissible when the mean length of path is small compared with the dimensions of the vessel. For the sake of simplicity we make abstraction of the individual molecules, and feign to our imagination *continuous* matter of which the fundamental properties—such as pressure varying as the density, and so forth—are ascertained by experiment. A gas is nothing more than an assemblage of molecules contemplated from a simplified point of view When we deal with phenomena in which we are obliged to individually contemplate molecules, we must not speak of the assemblage as *gas*

An objection has been raised touching the existence of ultra-gaseous matter in highly-exhausted electrical tubes, that the special phenomena of radiation and phosphorescence which the author has considered characteristic of this form of matter can be made to occur at much lower pressures than that which exhibits the maximum effects For the sake of argument let us assume that the state of ultra gas with its associated phenomena is at the maximum at a millionth of an atmosphere. Here the mean free path is about 4 inches long, sufficient to strike across the exhausted tube But it has been shown by many experimentalists that at exhaustions so low that the contents of the tube are certainly not in the ultra-gaseous state, the phenomena of phosphorescence can be observed This circumstance had not escaped the author's notice. In his first paper on the "Illumination of Lines of Molecular Pressure and the Trajectory of Molecules"[1] the author drew attention to the fact that a molecular ray producing green phosphorescence can be projected 102 millimetres from the negative pole when the pressure is as high as 0 324 millim or 427 M In this case the mean free path of the molecules is 0·23 millim., and it is not surprising that with more powerful induction discharges, and with special appliances for exalting the faint action to be detected, the above-named phenomena can be produced at still higher pressures.

It must be remembered that we know nothing of the *absolute* length of the free path or the *absolute* velocity of a molecule; these may vary almost from zero to infinity. We must limit ourselves to the *mean* free path and the *mean* velocity, and all that these experiments show is that a few molecules can travel more than a hundred times the *mean* free path, and with perhaps a corresponding increase over the *mean* velocity, before they are stopped by collisions With weak electrical power the special phosphorogenic action of these few molecules is too faint to be noticed, but by intensifying the discharge the action of the molecules can be so increased as to render their presence visible. It is also probable that the absolute velocity of the molecules is increased so as to make the mean velocity with which they leave the negative pole greater than that of ordinary gaseous molecules. This being the case, they will not easily be stopped or deflected by collisions, but will drive through obstacles and so travel to a greater distance.

If this view is correct, it does not follow that gas and ultra gas can co-exist in the same vessel. All that can be legitimately inferred is, that the two states insensibly merge one into the other, so that at an intermediate point we can by appropriate means exalt either the phenomena due to gas or to ultra gas. The same thing occurs between the states of solid and liquid and liquid and gas. Tresca's experiments on the flow of solids prove that lead and even iron, at the common temperature, possess properties which strictly appertain to liquids, whilst Andrews has shown that liquid and gas may be made to merge gradually one into the other, so that at an intermediate point the substance partakes of the properties of both states

Note on the Reduction of Mr. Crookes's Experiments on the Decrement of the Arc of Vibration of a Mica Plate oscillating within a Bulb containing more or less Rarefied Gas[2]

THE determination of the motion of the gas within the bulb, which would theoretically lead to a determination of the coefficient of viscosity of the gas, forms a mathematical problem

[1] *Proceedings* of the R S, No 193, 1879, p 347
[2] *Proc* R S, No 208, 1880, p 239
[3] *Proc* R S, No 205, 1880, p 469

[1] *Phil. Trans* part 1, 1879, the Bakerian Lecture
[2] Abstract of a paper read before the Royal Society, February 17, by Prof. G G Stokes, Sec R S

of hopeless difficulty. Nevertheless we are able, by attending to the condition of similarity of the motion in different cases, to compare the viscosities of the different gases for as many groups of corresponding pressures as we please. Setting aside certain minute corrections which would have vanished altogether had the moment of inertia of the vibrating body been sufficient to make the time of vibration sensibly independent of the gas, as was approximately the case, the condition of similarity is that the densities shall be as the log decrements of the arc of vibration, and the conclusion from theory is that when that condition is satisfied, then the viscosities are in the same ratio. Pressures which satisfy the condition of similarity are said to "correspond."

It was found that on omitting the high exhaustions, the experiments led to the following law.—

The ratios of the viscosities of the different gases are the same for any two groups of corresponding pressures. In other words, if the ratios of the viscosities of a set of gases are found (they are given by the ratios of the log decrements) for one set of corresponding pressures, these pressures may be changed in any given ratio without disturbing the ratios of the viscosities.

This law follows of course at once from Maxwell's law, according to which the viscosity of a gas is independent of the pressure. It does not however by itself alone prove Maxwell's law, and might be satisfied even were Maxwell's law not true. The constancy however of the log decrement, when the circumstances are such that the molar inertia of the gas may presumably be neglected, proves that at any rate when the density is not too great that law is true; and the variability of the log decrement at the higher pressures in all but the very light gas hydrogen is in no way opposed to it, though Mr. Crookes's experiments do not enable us to test it directly, but merely establish a more general law, which embraces Maxwell's as a particular case.

The viscosities referred to air as unity which came out from Mr. Crookes's experiments were as follows:—

Oxygen	1·117
Nitrogen and carbonic oxide	0 970
Carbonic anhydride	0 823
Hydrogen	0 500

The viscosity of kerosoline vapour could not be accurately deduced from the experiments, as the substance is a mixture, and the vapour-density therefore unknown. Assuming the relative viscosity to be 0 0380, the vapour-density required to make the experiments fit came out 3 408 referred to air, or 49·16 referred to hydrogen.

When once the density is sufficiently small, the log decrement may be taken as a measure of the viscosity. Mr. Crookes's tables show how completely Maxwell's law breaks down at the high exhaustions, as Maxwell himself foresaw must be the case. Not only so, but if we take pressures at those high exhaustions which are in the same ratios as "corresponding" pressures, the log decrements in the different gases are by no means in the ratios of the densities.

It would appear as if the mechanical properties of a gas at ordinary pressures and up to extreme exhaustions (setting aside the minute deviations from Boyle's law, &c.) were completely defined by two constants, suppose the density at a given pressure and the coefficient of viscosity, but that specific differences come in at the high exhaustions at which the phenomena of "ultra-gas" begin to appear; and that to include these, an additional constant, or perhaps more than one, requires to be known.

ANIMAL REMAINS IN THE SCHIPKA CAVERN

ON December 6, 1880, Prof. Schaaffhausen gave a lecture to the Lower Rhine Society in Bonn, on the discoveries made by Prof. Maschke in the Schipka Cavern, near Stramberg, in Moravia. In this cavern were found remains of Bos, Ursus, Elephas, Rhinoceros, Leo, and Hyæna, besides roughly-hewn implements of quartzite, basalt, and flint, and some incisor teeth of Ursus, which were cut into on both sides at the beginning of the crown, perhaps because people did not yet know how to bore a hole into the root. Carbonised animal bones in numerous small fragments were met with. A solitary human relic was found in a protected place at the wall of a side passage of the cavern, and near a fireplace. It was the fragment of a lower jaw, amid ashes and inter-breccia of lime. The same layer contained mammoth remains and stone implements. Of the jaw only the front part with incisors, one canine, and the two premolars, of the right side remained. The latter three teeth were still in the jaw undeveloped, but were visible, because the front wall of the jaw was wanting. The largeness and thickness of the jaw, first of all, were remarkable. The teeth-development corresponds to the first year of life, but the jaw and the teeth are as large as those of an adult. As is the rule with man, the first pre-molar seemed nearest being cut, next to it came the canine, then the second pre-molar.

The height of the jaw in the line of symphysis measures, to the alveolar border, 30 mm., to the end of the incisors 39 mm. (In the jaw of a child seven years old the corresponding measurements were 23 mm. and 30 mm., in a girl nine years old 24 mm. and 33 mm., in a boy of 12, 22 mm. and 31 mm. The jaws of eight adults measured in height, to the alveolar border, on an average, 31 mm.) The jaw fragment, at its lower border, in the line of symphysis, is 14 mm. thick, under the canine tooth the thickness is 15 mm. (In an ordinary adult jaw the thickness in the line of symphysis is about 11 mm.) Now when the cutting surface of the incisors is placed horizontally, the under part of the prognathous jaw bends so much back that one misses the chin as a prominence. A vertical from the front alveolar border falls 4 to 5 mm in front of the lower border of the jaw. The hinder surface of the symphysis is placed obliquely, as occurs in a high degree in the anthropoids, and in lower degree in savage races, but has also before been observed in fossil human remains, as in the jaw of La Naulette, to which this jaw from the Schipka Cavern has much similarity. The form of the incisors is adapted to the thick prognathous jaw, the broadest part of the root measures from front to back 8¼ mm, whereas the ordinary measurement here is 6 mm. Further the teeth are bent convex in front. The curvature corresponds to a radius of 27 mm. The *spina mentalis interna* is absent, and instead there is, as in the anthropoids, a cavity, at the lower border of which some unevenness can easily be felt. The prominences for attachment of the *Musculi digastrici* are well marked, implying a correspondingly strong development of the antagonistic muscles, the masticatory. All these features were also met with on the jaw of La Naulette, but more developed. It is probable that the jaw of the Schipka Cavern also had the pithecoid peculiarity, that its tooth-line was not horizontal, but rose from the premolars to the incisors, and its body was higher in front than at the sides, because the cutting surface of the outer incisors sinks obliquely outwards. The size of the canine tooth is remarkable, its enamel crown being 13 5 mm. long. (In the fossil lower jaw of Uelde the canine tooth exceeds the premolars about 3·5 mm. According to measurement on ten European adult skulls with the teeth hardly, or not at all, worn down, the crown of the canine tooth was 11 5 mm. long. Only once, among more than fifty skulls, was it found 14 mm.) It cannot well be supposed that this jaw, caught in dentition, belonged to an individual of giant growth, since in such individuals the excessive growth, according to Langer, first begins about nine to ten years of age. The assumption that some pathological cause had hindered the development of the three teeth that remained within the jaw seems quite groundless. As little can we suppose that in the prehistoric time the teeth development was retarded, and that the change of teeth occurred at a later age, since a quicker development corresponds to a lower organisation. (All mammals come into the world with teeth, and the orang changes its teeth sooner than man.)

The size of the front part of the jaw however may in itself be regarded as pithecoid; and there is more reason for this in that other pithecoid characters are present. The aspect of the grey-yellow bone with small dark branching spots on it is met with often in cavern bones. The enamel of the teeth is quite like that of the Quaternary cave animals; it shows longitudinal fissures with dark infiltration; while near these appear bluish, and in some places yellow, spots.

SOME REMARKS ON PERIPATUS EDWARDSII, BLANCH.

SINCE I learnt from Mr. Moseley's notes on the species of *Peripatus* (*Ann. and Mag. of Nat. Hist.*, v. ser., iii., 263), that one of them, referred by Grube to *P. Edwardsii*, had been obtained from this country, in the neighbourhood of Colony Tovar[1], I tried to get specimens of this highly interesting

[1] Not Colony *Jowar*, as the name is printed in Mr. Moseley's paper.

animal. But all my efforts being unsuccessful for a long time, I finally lost all hopes, and the pressure of other business, scientific and not scientific, caused me to lay the matter on the shelf, little thinking that I had my *desideratum* close at my elbows

There is within our University building a large square yard, where stones, old bricks, and other such refuse had been accumulating in the course of years. About a month ago it was fortunately resolved to transform this very ugly place into a garden, and I engaged the workmen to bring me any kind of animal they might turn up under the heaps of rubbish. How great was my satisfaction to find in the very first gatherings half a dozen of *Peripatus* among some common beetles, centipedes, and earthworms! I offered immediately a prize for every other specimen of the former, and so good proved the locality that in a few days I was in possession of more than fifty of these unexpected *cives academici* of ours, the supply being apparently far from exhausted.[1]

As there are still some points in the natural history of *Peripatus* which are not well settled, I beg leave to offer the following remarks based on the careful examination of living or dissected specimens

The number of females appears to be much larger than that of males, for among fifty three specimens I found only five males, which are about half the size of the females. These are

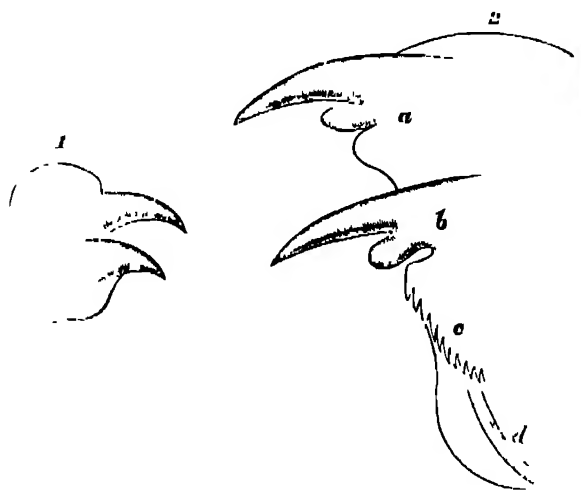


FIG 1 FIG. 2

FIG 1 —Horny claws of one of the foot jaws in the young animal when born FIG 2 —The same, from an adult female *a*, first claw, *b*, second claw, *c*, horny saw, *d*, pigment-line

sometimes nearly 1 decimetre long, 5 to 6 millimetres broad, and somewhat tapering on both extremities The colour is brownish black, with a diffused black line on the middle of the back, the ventral side is dark flesh-coloured Full grown animals have thirty-one pairs of ambulatory feet, the new-born animals have but twenty-nine, the length of the latter is about 25 millimetres, their breadth two, the tentacles measure 3 mm; their colour is reddish, with a line of somewhat lozenge-shaped figures of a paler tint running down the middle of the back

I twice observed the birth of a young *Peripatus*. The mother raised slightly the hind part of the body, moving it slowly from one side to the other. After some minutes the head of the embryo protruded from the sexual porus, and in half an hour half the body came out, twisting around all the while in every direction The old animal remained rather quiet, moving occasionally its head, but not crawling about. As soon as the process was advanced thus far, the young *Peripatus* clung with its feet to the nearest surface in its reach; and the mother walking off, the hind part of the embryo came forth in a few seconds

In one case a young *Peripatus* was born in a tumbler of water, in which I had placed the mother, in order to kill it in an extended condition, as recommended by Moseley in his well-known paper in the *Phil. Transactions*. I did not see the birth, but found the young animal already crawling on the back of the mother, and there floated in the water close by a very thin skin of the size of the young animal, exhibiting its whole form, even the tentacles. I suppose it must have been shed soon after birth, but have failed hitherto to see anything alike in the other cases of birth, which I watched very carefully.

I could not well make out the number of articulations in the tentacles, there are, however, more than thirty in those of the young animal, having each a ring of short spiny bristles at the base. The slime-glands of the young *Peripatus* are already well developed It has twenty-nine pairs of feet; and as the adult animal has never more than thirty-one, there must be specimens with the intermediate number of thirty, which would settle Mr. Moseley's question (*Ann and Mag of Nat Hist*, l c) It is probable that *Peripatus* goes through several moultings, and that the new feet then make their appearance

This may be further surmised from the development at the horny claws of the foot-jaws, which are simple, and not indented in the young animal, but of a much more complicate structure in the old one. The annexed figures represent these claws in both conditions.

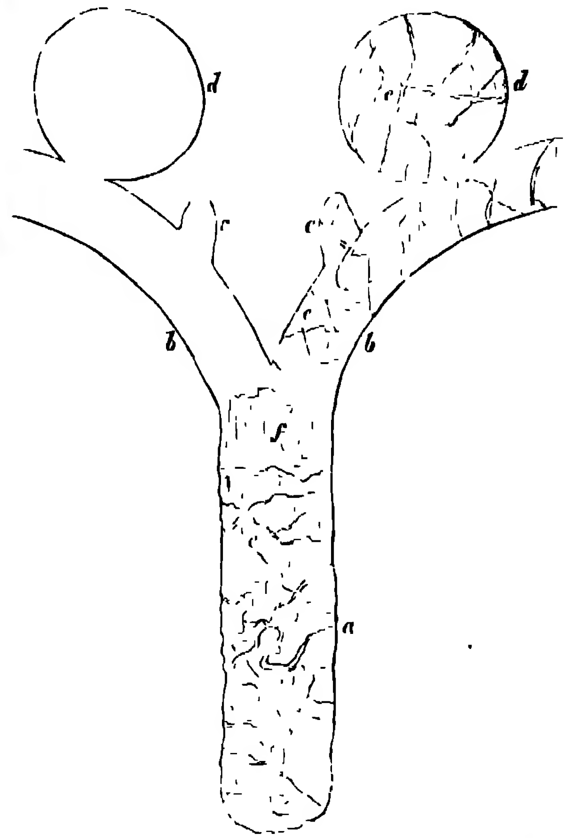


FIG 3 —Schematic sketch of ovary (*a*), beginning of oviducts (*b*), cæca (*c*), receptacula seminis (*d*), covered by tracheal tubes (*e*), zone of ovary without tracheal tubes (*f*)

In the adult animal there is first a large pointed tooth, then follows a shorter one, which is obtuse; both are formed apparently of three to four superposed lamellæ, the outlines of which are distinctly visible by changing the focus of the microscope. The second maxillary claw has likewise two teeth of the same shape and structure, but bears behind them a kind of saw, composed of ten small teeth of the same amber-yellow colour as the inner parts of the larger teeth This saw is followed by an oblique line of a yellowish pigment, perhaps the rudiment of another developing saw, or a reservoir of horny matter.

The structure of the sexual organs may deserve a few remarks. There can be no doubt that the sexes are separate. The male organs are very much like those described by Moseley in his paper; only the *vesiculæ seminales* are not nearly so spirally twisted as in his figure on plate lxxii. The testes contain spermatozoa of the same shape as those of *P Capensis*. I noticed

[1] Those desirous of obtaining specimens from me in exchange for books or papers on zoological topics, will be good enough to write to me.

that the slime-glands were much less developed in the males than in the females.

The structure of the female organs in our Caracas species agrees pretty well with Prof. Hutton's drawings (*Ann. and Mag of Nat. Hist*, iv. ser., vol 18, pl xvii, fig 8); but I am not prepared to accept his interpretation The following sketch will give an idea of what I saw

Moseley's Fig. 1 on pl. lxxiv is very different from the shape of the ovary in our species; nor can I well understand the existence of ova on the *outside* of the ovary as they appear in his drawing. The ovary in *P. Edwardsii* is rather long, and abundantly covered by fine tracheal tubes, with the exception of a narrow zone close to the branching out of the oviducts. I could not satisfy myself as to its being div ded by a septum, nor could I find any ova in it; most likely it is not now the right time At a very short distance from the beginning of the oviducts there is a kind of obtuse *cæcum* on each of them, which is followed by a spherical body covered by tracheal tubes These bodies are the organs described by Prof Hutton as testes

There is however in our species no trace of what he takes for *vasa deferentia*, the spherical body adhering directly to the oviduct Its wall is of considerable resistance, and bursts only under great pressure, giving issue to an immense number of thin rod-like corpuscula, which soon after begin to move slowly in the surrounding water They are of course spermatozoa which have lost their nuclei, and the spherical body can therefore be nothing else but a *receptaculum seminis*.

The oviducts of three specimens which I dissected contained very few embryos, in one there was only one in each oviduct, in the others there were two They were fully developed, and occupied the part of the oviducts close to the vulva. It would appear from this that the time of reproduction is now almost over; further observations will show whether there is really such a periodicity in our species

It is probable that the oviducts of *P. Edwardsii* never present the shape of strings of sausages, as seen by Mr. Moseley in *P Capensis*, the embryos being so considerably larger.

Animals thrown alive into alcohol pour forth from their slime-glands first the viscid substance contained in these, then there comes out a slightly reddish matter, which dissolves in the alcohol, giving it the same colour

With respect to all other points I can only confirm Mr. Moseley's statements I keep alive a colony of *Peripatus* of both sexes in the hope to have once a chance to observe the copula

I cannot conclude these remarks without confessing that I am not at all quite sure whether our *Peripatus* is really *P. Edwardsii*, as the figure of this species in Nicholson's "Manual of Zoology" (5th edit. p 315), which is said to be after Grube, does not agree well with my living specimens Grube's original paper I cannot consult here It may be however that he made his drawing from a contracted alcoholic specimen. A. ERNST

The University, Carácas, January 16

ACOUSTICS IN CHINA

THE following letter to Prof. Tyndall has been sent to us for publication by the writer, Mr. Fryer It will be seen that a really scientific modern correction of an old law has singularly turned up from China, and has been substantiated with the most primitive apparatus. Dr. W. H Stone, to whom the letter has been submitted, has kindly appended a note

TO PROF TYNDALL, LL.D., F.R S, &c.

DEAR SIR,—My friend Mr. Hsu has brought some interesting facts relating to acoustics before my notice. As he is the father of the native official who translated with me your work "On Sound," and as he refers particularly to that work, I venture to forward you a translation of his remarks, in the hope that you will satisfy his mind on a subject in which he takes such deep interest. He says —

"In ancient Chinese works on music it is stated that strings or pipes produce an octave or twelve semitones higher or lower by halving or doubling their length.

"In a work written during the Ming dynasty by Chen-tsai-yoh it is stated that this rule will only hold good with strings, but not with open pipes such as the flute or flageolet.

"Some years ago I tried to investigate the cause of this difference and its exact amount. A round open brass tube, say nine inches long, gave a certain note by pressing the end of it against the upper lip and blowing through an *embouchure* made there. Cutting off half the tube, the remaining four and a half inches would not sound the octave; but by cutting off half an inch more, thus leaving four inches in length, the octave was sounded accurately. This experiment was tried on tubes of various lengths and diameters with a similar result, viz. that four-ninths of the length always sounded the octave more or less exactly. Looking at a foreign keyed flute I noticed the same principle carried out in the arrangements for producing octaves. I could not however see the reason why open pipes should not follow the same rule as strings and closed pipes.

"When I read the translation of Prof Tyndall's treatise 'On Sound,' I was surprised to find the old Chinese idea strictly maintained. It says (p 214) 'In both stopped and open pipes the number of vibrations executed in a given time is inversely proportional to the length of the pipe,' &c. According to this, as the octave of any note has to execute exactly double the number of vibrations in a given time, an open pipe ought to be exactly halved to make it sound an octave higher. This I have shown to be erroneous by my experiments.

"Fearing that I have misunderstood the English professor's meaning, I beg that he may be written to on this subject, and that my doubts may be thereby cleared up. What I want to know is the exact proportion in length that exists between any open pipe and a pipe of similar diameter sounding its octave higher Also the exact proportions in length for each of the open pipes sounding the twelve semitones which form a scale of one octave. If the length forming the octave in open pipes does not agree with the length for strings or closed pipes, then the lengths of all the pipes giving intermediate notes must also differ. How are these lengths to be calculated? Can they be expressed by any mathematical curve or formula? Why does not the same rule hold good for open pipes as for strings or stopped pipes? I have a theory of my own, but I do not feel sufficient confidence in myself to make it public until I have bestowed more thought and attention upon it In the meantime I shall be glad if any foreign scientists can enable me to understand this interesting and important subject The theory and practice of music in China has gradually become vitiated through errors in the construction of musical instruments, and I am therefore desirous of having a scientific basis upon which a reformation may be effected"

There is no treatise on music or acoustics that I can find which throws any light on these interesting questions, and I shall therefore deem it a great favour if you will direct me to any work that will enable me to satisfy the eager inquiries of my native friend

I send by book post a pamphlet for your kind acceptance, containing an account of the Department for the Translation of Scientific Books at the Kiangnan Arsenal. You will see that your "Notes on Light" are now published in Chinese. A copy will be forwarded to you shortly. Your "Heat a Mode of Motion" I hope to begin to translate at no very distant time. Your "Notes on Electricity" in Chinese will be published shortly

I remain, dear Sir, yours faithfully,

Shanghai, June 1, 1880 JOHN FRYER

November 25th, 1880

P.S.—I have sent a copy of this letter to the Editor of NATURE, and shall feel greatly obliged if you will forward your reply, if any, to him for publication.—J. F.

MR. FRYER is perfectly correct in his observations. You will find the explanation and formula needed at p. 167 of my little book on Sound, under the heading "Correction of Bernouilli's Law." "It has long been known," I there say, "that if an open pipe be stopped at one end its note is not exactly an octave below that given by it when open, but somewhat less, the interval being about a major seventh instead of an octave."

Then follows the mathematical statement, from which the corrections needed by Mr Fryer could easily be obtained. M. Bosanquet's excellent experimental investigation of the subject is briefly described. His results give the correction for the open end of the pipe as ·635 of radius of pipe, and 59 *r* for the mouth Mr. Bosanquet remarks that in Bernouilli's theory the hypothesis is made that the change from the constraint of the pipe to a condition in which no remains of constraint are to be perceived takes place *suddenly* at the point where the wave system leaves the pipe. It is however evident that the divergence which takes place may be conceived of as sending back to the pipe *a series* of reflected impulses, instead of the single

reflected impulse which returns from the open end of the pipe according to Bernoulli's theory, and that these elementary impulses, coming from different distances, may be altogether equivalent to a single reflected impulse from a point at a little distance from the end of the pipe. It is not a little interesting that a confirmation of this little-known fact should have come from so far off, and have been obtained by such simple experimental means. W. H. STONE

14, Dean's Yard, S.W., January 8

SCIENTIFIC SERIALS

Annalen der Physik und Chemie, No. 13, 1880.—On currents of motion in polarised platina, by H. Helmholtz.—On the course of polarisation currents, by A. Witkowski.—On the changes of form and volume of dielectric bodies wrought by electricity, by W. C. Röntgen.—On Lichtenberg figures and electric valves, by W. von Bezold.—On the electromotive forces of some zinc-copper elements, by Fr. Fuchs.—On the measurement of electric conductivities, by G. Kirchhoff.—Some experiments on induction in conductors, by F. Himstedt.—On the discharge of electricity in rarefied gases, by E. Goldstein.—On the production of harmonic tones through vibrations of a fundamental tone, by R. Koenig.—Researches on the law of dispersion, by O. Hesse.—On fluorescence, by S. Lamansky.—On the law of heat-radiation and the absolute emission power of glass, by L. Graetz.—On annealing of steel and measurement of its hardness, by V. Strouhal and C. Barus.—On the height of the atmosphere (continued), by A. Ritter.—Researches on the volume-constitution of liquid compounds, by H. Schröder.—On variations of the sea-surface by reason of geological changes, by K. Zöppritz.—On the theory of Volta's fundamental experiment, by F. Exner.—The theory of the galvanic element, by the same.—Note on the quantities of heat carried away by currents of an unequally heated liquid, by A. Oberbeck.—Note on Herr Siemens' recent paper on electric conductivity of carbon and temperature, by J. Borgmann.

No. 1, 1881.—New researches on Newton's rings, by L. Sohncke and A. Wangerin.—On vapour tension of homologous esters, by O. Schumann.—On the elasticity and the electric conductivity of carbon, by W. Beetz.—Thermal theory of the galvanic current, by J. L. Hoorweg.—On electric light phenomena in gases, by E. Goldstein.—On the phenomena of glow at metallic electrodes within a hydrogen atmosphere of varying pressure, by O. Lohse.—Note on Riecke's paper on the electric elementary laws, by H. Lorberg.—Clausius' law and the motion of the earth in space, by J. Fröhlich.—On the application of the proposition of the virial in the kinetic theory of gases, by H. A. Lorentz.—On the influence of expansion of molecules on the pressure of a gas, by D. J. Korteweg.—On the velocity of light in various quartz surfaces, by W. Hallock.—Reply to Herr Dorn, by E. Edlund.—On tones arising through intermittent radiation on a gas, by W. C. Röntgen.—On phenomena of diffraction before the border of a screen, by O. Tumlirz.

THE *Journal of Physiology*, vol. iii. No. 2, January, contains: Dr. S. H. Vines, on the proteid substances contained in the seeds of plants. To this important paper is appended a classification of aleurone grains and a classified list of the plants whose seeds were examined.—Dr. Sydney Ringer, the influence of season and of temperature on the action and on the antagonisms of drugs.—Dr. C. S. Roy, the elastic properties of the arterial wall, with plates v.-vii.—Dr. J. Ott, on crossed hyperæsthesia, and notes on inhibition.

Journal of the Royal Microscopical Society, ser. ii. vol. i. part 1, February, contains Dr. C. T. Hudson, on *Œcistes janus* and *Floscularia trifolium*, two new species of Rotifers (plates 1 and 2), and the usual summary of current researches relating to zoology and botany, microscopy, &c.—The minutes of the proceedings of the Society are given at the end of the part.

Journal of the Franklin Institute, February.—On the revolution of a fluid ellipsoid with three unequal axes, by T. Craig.—A newly-discovered property of the ellipse, and its application to the "oval chuck," by F. M. Leavitt.—A simple-transmission-dynamometer, by E. Thomson.—Methods for judging of the wholesomeness of drinking-water, by R. Haines.—The basic dephosphorising process, by J. Reece.—Riehle Brothers' improved vertical testing machine, 50,000 pounds capacity.

THE *American Naturalist*, February, 1881.—L. F. Ward, incomplete adaptation as illustrated by the history of sex in plants.—Sarah P. Monks, a partial biography of the green lizard.—G. K. Morris, a new leaf cutting ant.—S. V. Clevenger, comparative neurology (continued).—Justin Spaulding, the bee's tongue, and glands connected with it.—Wm. E. Doyle, history of the buffalo.

Revue Internationale des Sciences biologiques, January 15, 1881.—Prof. Hanstein, protoplasm considered as the basis of animal and vegetable life.—D. Debierre, an introduction to the earth's history.—Ch. Letourneau, the ethics of egoism (Schopenhauer's "Aphorisms on Moderation in Life").—J. L. de Lanessan, digestion in vegetables.

The Proceedings of the Linnean Society of New South Wales, vol. iv. part 4, Sydney, 1880.—John Brazier, synonomy of, and remarks upon, Port Jackson, New Caledonian, and other shells, with their distribution; list of land-shells found on Thursday Island, with description of new species; Port Jackson and New South Wales brachiopods; mollusca recently dredged at Port Jackson Heads; on the locality of *Oniscia ponderosa*.—E. P. Ramsay, on an undetermined species of Lalage; contribution to the zoology of New Guinea, part 6.—W. A. Haswell, supplementary note on Australian Leucosiidæ; on Australian *Brachyura Oxyrhyncha*, plates 25, 27.—C. Jenkins, on the geology of Yass Plains (3).—W. Macleay, on the Mugilidæ of Australia.—C. S. Wilkinson, on the Abercrombie caves.

Journal of the Asiatic Society of Bengal, vol. xlix. part 2, No. 2, August 30, 1880, contains.—Alexander Pedler, on the past and present water supplies of Calcutta.—R. Lydekker, on the zoological affinities of the bharal or blue sheep of Tibet. While forming a very closely connecting link between the sheep and the goat, the author thinks it cannot be referred to either of the genera Ovis or Capra, and that Hodgson's genus Pseudovis should be retained for its reception.—J. Wood-Mason, on a new butterfly (*Hebomoia Roepstorfii*) from South Andaman, near *H. sulphurea*, Wallace.

Journal de Physique, February.—On radiophony, by E. Mercadier.—Researches on the differences of potential of two metals in contact; results, by H. Pellat.—Dr. Cusco's lens with variable focus, by C. M. Gariel.—On the correction of cooling in calorimetry, by M. Berthelot.—Edelmann's universal support for physical experiments, by A. Terquem.

SOCIETIES AND ACADEMIES

LONDON

Zoological Society, March 1.—Prof. W. H. Flower, F.R.S., president, in the chair.—The Secretary exhibited the cast integument of a large spider (*Mygale bistriata*?) which had been shed in the Society's Gardens.—Mr. G. E. Dobson, C.M.Z.S., read a paper on the anatomy of the family *Erinaceidæ*, commencing with that of the curious and rare form *Gymnura Rafflesii*, with which the species of *Erinaceus* were compared. *Gymnura* was shown to be a peculiarly central form, the survivor probably of a once widely-spread group. Altogether the anatomy of thirteen species of Erinaceidæ was treated of in this paper.—A communication was read from Mr. F. Moore, F.Z.S., containing the descriptions of some new genera and species of Asiatic nocturnal lepidoptera. The characters of 150 new species were given, representing eighty two genera, of which twenty-nine were new to science.—A communication was read from Mr. R. Collett, C.M.Z.S., containing an account of the breeding habits of the grey seal (*Halichoerus grypus*), as observed on the Fro Islands, off Trondhjem's Fiord, in Norway.—Mr. R. Bowdler Sharpe, F.Z.S., read a note on the fantail flycatcher of Western Australia (*Rhipidura preissi*), of which he had lately had for the first time an opportunity of examining a specimen.

Geological Society, February 23.—Robert Etheridge, F.R.S., president, in the chair.—William Henry Goss was elected a Fellow of the Society.—The following communications were read:—A letter from Dr. John Kirk, communicated to the Society by the Right Hon. Earl Granville, dated H.M. Agency and Consulate General, Zanzibar, December 20, 1880. "It may be of interest to record the occurrence here of an earthquake shock felt in the island of Zanzibar at 6.58 a.m., mean time, on the morning of the 18th inst. Although the shock was very distinct no damage appears to have been done to any buildings in town. It is now twenty-four years since a similar shock has been here noticed; but on the mainland, espe-

cially in the vicinity of Ujiji, they are both more common and more severe than at the coast. Shortly after the cable was laid between Mozambique and Delagoa Bay, the communication was suddenly interrupted after one of these earthquake shocks, which seems to have caused the falling in of rocks by which the cable was crushed."—The Permian, Triassic, and Liassic rocks of the Carlisle Basin, by T. V. Holmes, F.G.S. The district discussed in the author's paper was worked over by him when engaged on the geological survey, and consists of those parts of Cumberland and Dumfriesshire which adjoin the Solway. Its southern boundary is, approximately, a line ranging from Maryport to Rose Castle on the River Caldew, and touching the Eden about two miles above Wetheral. On the east and north-east its limits are the immediate neighbourhoods of the junction of the rivers Eden and Irthing, Hethersgill on the Hether Burn, Brackenhill Tower on the Line, and the border boundary on the Rivers Esk and Sark; and in Dumfriesshire the small tract south of a line ranging from the junction of Scots Dyke with the Sark on the north-east, to Cummertrees on the south-west. The lowest bed in this area is the great Upper Permian or St. Bees Sandstone, which occupies a belt of country in the neighbourhood of the outer boundary. Directly above St. Bees Sandstone, in the west of the district, lies a formation consisting of shales with gypsum, which, though 700 feet thick in the neighbourhood of Abbey Town, is nowhere visible, but is known solely from borings, the country west of the Caldew, and of the Eden below the junction of the two streams, being thickly drift-covered and almost sectionless. In the east of the district the St. Bees Sandstone is overlain directly by a soft, red, false-bedded sandstone, called by the author Kirklinton Sandstone, from the locality in which the rock is best seen, as well as its relations to the under- and overlying beds. But while there is no evidence of any unconformity between the St. Bees Sandstone and the overlying Gypseous Shales in the west, there is evidence of a decided unconformity between the St. Bees and Kirklinton Sandstones in the east. In Carwinley Burn (for example), which runs into the Esk at Netherby, only from 200 to 300 feet of St. Bees Stone was seen below the outcrop of the Kirklinton, instead of the 1000 to 1500 feet which probably exist about Brampton on the one hand, and in Dumfriesshire on the other. Yet Carwinley Burn affords an almost continuous series of sections, from the (non faulted) Permian-Carboniferous junction to some distance above the outcrop of the Kirklinton Sandstone. As, in addition, the shales underlying the St. Bees Sandstone are gypseous, both near Carlisle and at Barrowmouth, close to St. Bees Head, the author classed the (Upper) Gypseous Shales as Permian, and the Kirklinton Sandstone as Bunter. Resting unconformably on the Kirklinton Sandstone, in the district between Carlisle and Kirklinton, are the Marls seen on the Eden, between Stanwix and Beaumont, and on the line between Westlinton and Cliff Bridge, Kirklinton. Their unconformity is shown by the fact that on the line they rest on the lower, or red, beds, and between Stanwix and Beaumont on the upper, or white, beds of the Kirklinton Sandstone. The Marls have therefore been classed as Keuper. So far as the evidence goes they appear to be very thin, and to extend but a very small distance south of the Eden. Lastly, the Lias appeared to the author to be unconformable to all the beds below, and to rest partly on the Gypseous Shales, partly on the Kirklinton Sandstone, and partly on the Keuper Marls. Of the existence of Rhætic beds there was no evidence, all fossils hitherto found having been determined by Mr. Etheridge (the president) to be Lower-Lias forms. But the Lias-sections are so small and few in number, and the ground so persistently drift-covered, that only a boring could settle the question.—On *Astroconia Granti*, a new Lyssakine Hexactinellid from the Silurian formation of Canada, by Prof. W. J. Sollas, M.A., F.G.S. This paper contained a description of a new fossil Hexactinellid sponge from the Niagara chert beds of Hamilton, Ontario. It is the second oldest known example of the Lyssakina.

Anthropological Institute, February 8.—Major-General A. Pitt-Rivers, F.R.S., president, in the chair.—The election of the following new members was announced: A. G. Geoghegan, E. H. Man, Owen Roberts, and Bruno Muller.—Mr. W. L. Distant exhibited some Carib chisels from Barbadoes, which had been sent to him by Mr. W. J. Sollas, of Bristol. They were taken with about 100 more from a cave, and were found six or eight inches below the surface. The cave is about 350 feet above the sea level, and is situated at a distance of two miles from the coast.—Mr. A. L. Lewis read a paper on two stone circles in Shropshire. Between five and six miles west of Minsterly is a circle of small stones known as the "Hoarstone." The largest stone is in the centre and is surrounded by thirty-three stones and fragments arranged in a circle about 74 feet in diameter. About a mile and a half in a south-westerly direction from the Hoarstone is another circle called in Gough's "Camden's Britannia" "Madge's Pinfold." Here thirteen stones and three fragments stand and lie in an oval ring, the diameters of which are about 86 feet and 92 feet, the longest diameter running north-west and south-east.—Miss A. W. Buckland read a paper on surgery and superstition in neolithic times, the object of which was to bring before the Institute the frequent use of trepanning in Neolithic times, as proved by the late Dr. Broca; to call attention to the proofs he has given of the facts, and to his explanation of the reason of the practice, and of the superstitions associated with it, as also its connection with the use of cranial amulets.

Physical Society, February 26.—Prof. Fuller in the chair. The former resolution regarding the moneys of the Society for investment was adopted.—Dr. O. J. Lodge exhibited a mechanical apparatus illustrating the fact that conductors of electricity are opaque to light, and showed by means of a Wheatstone's photometer, which combines two circular motions into a harmonic one, how the plane of polarisation of a beam of light passing through a magnetic medium is rotated.—Mr. C. V. Boys exhibited his new integrating machine, which is the only one illustrative of the mathematical process of integration, and is therefore specially valuable for teaching purposes.—Mr. Shelford Bidwell read a paper on the telegraphic transmission of pictures of natural objects. The process is explained as follows:—The positive pole of a battery is connected through a set of resistance coils to a piece of platinum wire, and the negative pole to a plate of zinc, upon which is placed a sheet of paper moistened with a solution of potassium iodide. The negative pole of a second battery is connected through a selenium cell with the same platinum wire, and the positive pole to the zinc plate. The point of the platinum wire is pressed upon the paper, and the selenium being exposed to a strong light, the variable resistance is so adjusted that the currents from the two batteries which pass through the paper in opposite directions exactly neutralise each other. The platinum point will now make no mark when drawn over the paper, but if the selenium is shaded, its resistance is immediately increased, the current from the first battery then predominates, and the path of the platinum point across the paper is marked by a brown line due to the liberation of iodine. The line is fainter the feebler the light is. This arrangement has been applied by Mr. Bidwell in his "telephotograph," exhibited to the meeting. The transmitter consists of a brass cylinder mounted on a screw spindle which carries the cylinder laterally $\frac{1}{15}$ inch at each revolution. A pin-hole in the middle of the cylinder allows light to fall upon a selenium cell placed behind it within the hollow cylinder. The cell is connected in circuit with a battery and the line. The receiver consists of a similar metal cylinder mounted so as to rotate synchronously with the first, and having a platinum point pressing upon a sheet of chemical paper wrapped round the cylinder. This receiver and transmitter are connected up as described above with two batteries and a set of resistance-coils. The image to be transmitted is focussed upon the cylinder of the transmitter and the resistance adjusted, and the receiving cylinder covered with sensitised paper. The two cylinders are caused to rotate synchronously, the pin-hole in the course of its spiral path covering successively every point of the focussed picture. The amount of light falling upon the selenium will be proportional to the illumination of that particular spot of the projected image which is for the time being occupied by the pin-hole, and the intensity of the line traced by the platinum point in the receiver will vary in the same proportion. These variations will produce a picture which, if the instrument were perfect, would be a counterpart of that projected upon the transmitter. Simple designs cut out of tin foil and projected by a lantern have been successfully transmitted. With selenium and paper of greater sensitiveness more perfect results might undoubtedly be obtained.—Professors Ayrton and Perry showed an experiment illustrating their plan for sending light and shade images by electricity. A selenium cell was connected in circuit with a battery and a coil of wire surrounding a tube along which a beam of light passed. A shutter having a small magnet attached was suspended in the tube like a galvanometer mirror, so that when a current traversed

the coils the shutter was deflected so as to close or partially close the tube and shut off the beam of light. It will be understood that when a ray of light fell on the cell and diminished its resistance, the current in the coils would increase to a degree proportional to the intensity of the ray, and thus the shutter would proportionally cut off the light in the receiver. If now a number of these elementary circuits were combined so as to provide a mosaic of cells to transmit the reflected image of an object, and a screen to receive the corresponding beams of light controlled by the shutters at the other end of the line, there would be a means of sending light and shade images by wire. A rapidly rotating arm carrying a row of cells upon it might answer for a stationary mosaic transmitter, and need fewer cells, while a Japanese mirror having its curvature altered by electromagnets behind might be made to act as a receiver, the "magic" images of that mirror being due to inequalities of curvature. Prof. Ayrton agreed with Mr. Bidwell in his conclusion that selenium cells of high resistance were more sensitive to light than cells of low resistance. Dr. Coffin suggested that Mr. Bidwell should adopt other than the cylindrical form of receiver, and move an image of the object across the pin-hole. Prof. G. C. Foster advised bringing the light always on one and the same part of the selenium cell.

Quekett Microscopical Club, February 25.—T. C. White, president, in the chair.—Ten new Members were elected, and numerous donations received.—A communication was made by Mr. A. D. Michael, announcing the discovery by Mr. Beaulah of *Myobia musculi* upon a mole, this parasite having been previously regarded as one confined to mice. A discussion ensued as to the frequent errors in classification and nomenclature arising from insufficient observation.—The Rev. J. E. Fase exhibited and described a convenient form of grooving slide, which could be used either with high- or low-power objectives.

Institution of Civil Engineers, February 22.—Mr. Abernethy, F.R.S.E., president, in the chair.—The paper read was on the weight and limiting dimensions of girder bridges, by Mr. M. am Ende, Assoc. M. Inst. C.E.

EDINBURGH

Royal Society, February 7.—Prof. Maclagan, vice-president, in the chair.—After reading the obituary notices of Lord Ormidale, Dr. Sharpey, Mr. Lassell, and other deceased Fellows, the chairman called on Prof. George Forbes to communicate his paper on a simple and accurate method of determining the longitude of a place by a single observer without the aid of any instrument for measuring time. The method consisted in taking advantage of the daily change in the moon's declination, which for four or five days during each lunation was sufficiently rapid to be measured with considerable accuracy by means of a sextant and artificial horizon. The calculations and reductions were too intricate to be effected save by a method of approximation and interpolation such as that which the author had given in his paper.—Mr. J. Y. Buchanan read a short paper from Prof. Liversidge descriptive of a specimen of Stilbite that had been brought by the *Challenger* from Kerguelen's Island.—Prof. J. Blyth gave an interesting account of certain experiments which he had made with a simple form of selenium cell. Two ordinary metal combs with every alternate tooth broken away were set close together, so that each remaining tooth in either fitted without touching into the interstice between two remaining teeth in the other. The two combs were then brought into electrical contact by the selenium, which was poured in between the teeth, and thus a selenium cell was formed with a large surface and small resistance. In one special form of cell the combs were bent round a glass tube, inside which a singing flame was set. The accompanying rhythmic fluctuations in the luminosity of the flame were reproduced as sound in the telephone receiver. The difficulty of getting good selenium at the time induced the author to try if amorphous phosphorus would serve as a substitute. A "radial cell," in which the interstices between the dove-tailing electrodes were filled with phosphorus, was found to be not sensitive to light; but such an arrangement was discovered to be a battery in itself, giving rise to currents which varied with the pressure that was brought to bear upon the phosphorus. This property at once suggested a phosphorus cell as a possibly useful transmitter in a telephonic circuit. Another curious effect was noted, viz. that phosphorus under the action of a variable current glowed with a beautifully varying phosphorescence.—Mr. Aitken communicated further experiments on the formation of fogs. His former experiments he had repeated at as low temperatures as 8° F., invariably finding that in filtered air no fog formed. Discussing the production of dry fogs, *i.e.* fogs that are formed in *non-saturated* air, the author pointed out that certain kinds of fog-forming dust were much more efficient in their action than others. Some, in virtue probably of their deliquescent properties, formed clouds in non-saturated air, others only acted in saturated air; while a third class required the air to be super-saturated. In connection with the change of state of moisture in the atmosphere, Mr. Aitken explained the formation of the various forms of ice-crystals by application of the principle that the slower the crystallisation the more regular and simple it is. Hence complex types of crystals betoken a rapid crystallisation. The paper ended with a few instructive remarks upon liquid surface-tension as an important factor in the growth and coalescence of rain-drops as they descend towards the earth.—Prof. Tait, in a short note on thermal conductivity, intimated that he had solved the equation for conduction, taking into account the temperature-variations of the conductivity and specific heat. He further pointed out that, at least in the case of iron, most of the decrease with temperature that apparently takes place in the value of the conductivity is in all likelihood referable at once to the change in specific heat, so that perhaps after all conductivity varies very slightly indeed with temperature, and is practically constant through ordinary ranges. Prof. Tait also gave a simple experimental illustration of the diminution in the surface tension of water produced by heating. A red-hot poker was held close over a level water surface on which Lycopodium dust was sprinkled, when at once the dust was drawn away to cooler regions as if violently repelled by the strongly-heated metal.—Dr. Haycraft communicated a paper in which he showed that the hepatic cells of man and other domestic animals, several of which he had examined, are possessed of true cell-walls. These may be demonstrated by placing a few scrapings from a fresh organ on a slide, and pressing the cover-glass down so as to crush them. The membranes are then to be seen projecting from the half-broken cells, or scattered about the preparation.

BOSTON, MASS., U.S.A.

American Academy of Arts and Sciences, February 9.—The president, Prof. J. Lovering, in the chair.—Prof. H. P. Bowditch presented some observations on the senses of sight and touch. An observer having noticed the position of a point at the centre of a target, shut his eyes, and after a measured interval of time attempted to touch this point again. It was found that the attempts were more successful when two seconds had elapsed than in the cases when more or less time had intervened.—Mr. N. D. C. Hodges read a paper upon the thermodynamic basis for the kinetic theory of gases. By means of the fundamental equations of thermodynamics the mathematical analysis of the kinetic theory results at once, and an expression is obtained for the absolute mass of a molecule.—Prof. Pickering, in a paper on variable stars, discussed their changes in brilliancy and grouped them according to a new law.—Mr. Arthur Searle gave some of the results of his observations on the zodiacal light.—Mr. Harold Whiting, in an abstract of a forthcoming paper, stated that he had found the rate of propagation of what may be called the magnetic wave to vary from 30 feet to 300 feet per second.—Prof. Goss presented some observations on the strength of fir beams.

PARIS

Academy of Sciences, February 21.—M. Wurtz in the chair.—The following papers were read:—Meridian observations of small planets at Greenwich and Paris Observatories during the fourth quarter of 1880, communicated by M. Mouchez.—On the parallax of the sun, by M. Faye. He indicates in a table nine methods of determining the earth's distance from the sun. He holds that the method of physicists is best, that the sun's parallax, 8″·813, is now determined by them to within $\frac{1}{100}$ of a second, and that the seven astronomical methods converge more and more towards this result, and tend to confirm it, without having equal certainty.—Male eels, compared with the females, by M. Robin.—General considerations on the Crustacean fauna of great depths in the Carribbean Sea and the Gulf of Mexico, by M. Alph. Milne Edwards. This deals with some results of the cruises in the *Blake*. Many new Crustacean species were obtained, and certain groups previously thought foreign to American waters were found abundantly at great depths. Anomouran and macrouran Crustacea there abound. Numerous forms intermediate between groups that have been thought very distinct are discovered (and the author cites several examples).—New clinical researches tending to prove that the cerebellum

is the co-ordinating nerve-centre for movements necessary to standing and walking, considered in all their forms, by M. Bouillaud.—On the systems of faults or diaclases which traverse the series of stratified formations; new examples furnished by Cretacean strata in the environs of Etretat and Dieppe, by M. Daubrée.—On Fuchsian functions, by M. Poincaré.—A letter of Ampère was presented.—On a class of Abelian integrals and on certain differential equations, by M. Picard.—On an integrator, or instrument for graphic integration, by M. Abdank-Abakanowicz.—On the cooling power of gases and vapours, by M. Witz. He infers equality of the cooling powers of dry air and air saturated with moisture. The cooling power of coal-gas compared with that of air is equal to 3·48, that of sulphurous acid does not exceed 0·61 (the pressure being 760 mm.). The velocities of cooling increase more quickly than the 1·233 power of the excesses. For steam they increase proportionally to the 0·83 power.—On the surfaces of revolution limiting liquids deprived of weight, by M. Terquem.—On radiophony: third note by M. Mercadier. He proves that the radiophonic effects are due to vibratory motion caused by alternate heating and cooling through intermittent radiations, principally in the gaseous layer adherent to the solid wall struck by these radiations; the anterior wall in opaque receivers, the posterior in transparent receivers.—Magic mirrors of silvered glass, by M. Laurent. He uses either pressed glass (polishing the surface opposite to the projections), or thin glass of commerce (engraving a hollow design on it).—On pyridic bases, by M. de Coninck.—On the hystolysis of the muscles of larva during the post-embryonic development of Diptera, by M. Viallanes. This relates to the phenomena of disappearance of muscles as the insect passes into the state of *pupa*.—On a new larva of Cestoides belonging to the type of the Cysticercus of Arion, by M. Villot.—On a new form of segmentary organ in Trematodes, by M. Macé.—Researches on the circulation and respiration of Ophiures, by M. Apostolidès. The circulatory system is formed of the general cavity and the spaces connected with it; and the respiratory sacs, by their alternate contraction and expansion, draw the blood into the peristomachal cavity, then drive it to the periphery. This explains how the sanguineous liquid, bathing all the organs, respires, and is set in motion.—On a method of coloration of Infusoria and anatomical elements during life, by M. Certes. Placed in a weak solution of chinoline blue, or cyanine, Infusoria take a pale blue colour, and may continue to live twenty-four to thirty-six hours. After twenty-four hours in a moist chamber, the white corpuscles of a frog's blood, coloured with cyanine (in serous solution) show amœboid movements. Chinoline blue is, *par excellence*, the reagent of fatty matter (which is quite absent in nuclei and nucleoli).—On the permanence of prussic acid during a month in the bodies of animals poisoned with this substance pure, by M. Brame. A rabbit and a cat were poisoned with 1 gramme of the substance each. In such dose it seems to preserve the animals perfectly at least a month, remaining in the tissues (especially those of the stomach), with which it seems to become intimately united.

February 28.—M. Wurtz in the chair.—The following papers were read:—On the attenuation of virus and its return to virulence, by MM. Pasteur, Chamberland, and Roux. The bacterium of *charbon* in artificial cultivation produces true germs (unlike the microbe of chicken cholera, which multiplies by division), whose virulence is not affected by air. This spore-production can be hindered by cultivation at 16° or at 42° to 43°. The mycelian product, in the latter case, becomes sterile after about a month; up to that point reproduction is easy, but the virulence is gone after the first eight days, in which time it passes through various stages of attenuation. The secret of causing a return of virulence consists in successive cultivation in the bodies of certain animals. The facts throw light on the etiology of epidemics.—Action of hydracids on halogen salts containing the same element, by M. Berthelot. Compounds so formed exist both in the case of alkaline salts, where they are denoted by absorption of gas, liberation of heat, and special reactions, and in the case of metallic salts properly so called, where they are obtained crystallised.—M. de Lesseps presented a fifth series of documents relating to the history of the Suez Canal.—On the disinfectant and anti-putrid action of vapours of nitrous ether, by M. Peyrusson. Its action is shown both from laboratory and hospital observations. It has the advantage of an agreeable and harmless smell.—On a new definition of the surface of waves, by M. Darboux.—On the development of the infinite product $(1-x)$, $(1-x^2)$ $(1-x^3)$ $(1-x^4)$ ... by Mr. Franklin.—On radiophony, by M. Mercadier. He makes *thermophonic piles*, or *phonic thermomultipliers* (after the analogy of electric thermomultipliers), for study of radiant heat, a single element consisting of a short glass tube containing a thin plate of smoked foil or mica, and several such being connected by caoutchouc or metal tubes. The air in these tubes vibrates longitudinally, and by lengthening them he gets *thermosonorous* pipes, having the same properties as ordinary sounding-pipes.—Application of Talbot's fringes to determination of the refractive indices of liquids, by M. Hurion.—On the displacement of the soda of chloride of sodium by hydrate of copper, by M. Tommasi. This takes place even at a low temperature (4° to 5°). With pure sodium chloride the reaction is almost instantaneous. Potassium chloride gives like results.—On the heats of combustion of some alcohols of the allylic series and of aldehydes which are isomeric with them, by M. Louguinine.—On the products of decomposition of proteic matters, by M. Blennard.—On a synthetic homologue of pelletierine, by M. Étard.—On a cause of alteration of canvas, by M. Balland. This relates to an observation by Dr. Tripier on some rusty-coloured hammock canvas used by the Algerian army in 1847. This showed dark spots after washing, and went to pieces in use. The spots were probably due to iron sulphide produced by alkaline sulphides in the artificial soda and by iron oxide fixed by the stuff in manufacture. The sulphide passed to the state of sulphate in air by a combustion involving the tissue.—Contribution to the study of trichinosis, by M. Chatin.—Contribution to the physiological action of urea and of ammoniacal salts, by MM. Richet and Moutard-Martin. *Inter alia*, it is singular that injection of a concentrated solution of urea increases the elimination of water more than of urea. In uremia death cannot be attributed to non-elimination of the ammoniacal salts of urine.—On the inflammatory nature of the lesions produced by the poison of the Bothrops serpent, by MM. Couty and De Lacerda.—On the pulmonary alterations produced by long stay in the purifying chambers of gas-works, by M. Poincaré. Animals kept eight months in those chambers showed in the lungs an accumulation of epithelial cells in some alveoli, but especially a prodigious nuclear proliferation in the connective tissue. This shows that it is not without danger to subject children with whooping-cough to similar treatment.—Relation of the cylinder axis and the peripheral nerve-cells with organs of sense in insects, by MM. Kunckel and Gazagnaire. In insects every nervous enlargement consists essentially of a bipolar cell (true nerve-termination), connected on one hand with the cylinder axis of the nerve-fibre, and on the other with a nerve-rod which is its prolongation; this rod is surmounted by a hair properly so called, or a transformed hair.—On the gemmation of Pyrosoma, by M. Joliet.—Antiquity of *Elephas primigenius* (Blum) in the sub-Pyrenean Valley, by M. Caraven-Cachin. It seems to have appeared first after the diluvium of the plateaux on the old Pleistocene spread, in a nearly horizontal sheet over Tertiary and other strata.

CONTENTS

THURSDAY, MARCH 17, 1881

SIR WILLIAM HERSCHEL[1]

II.

HERSCHEL'S removal from Bath to Datchet appears to have been brought about by the unwillingness he felt, at the time of his visit to London, to continue the toils of teaching, which, with the tastes he had now formed, his sister tells us, "appeared to him an intolerable waste of time," and he chose rather the alternative of a salary of 200*l* from the king. "Never bought monarch honour so cheap!" exclaimed his friend Sir Thomas Watson, to whom alone the sum was mentioned, all other inquirers being simply assured that "the king had provided for him." From letters received by the family at Bath during Herschel's stay in London, they had been led to infer that the king would not suffer him to return to his profession again. Herschel took part in the musical service at St. Margaret's Chapel at Bath for the last time on Whit-Sunday, 1782, when the anthem for the day was of his own composition.

On August 1 he arrived at Datchet. "The new home was a large neglected place, the house in a deplorably ruinous condition, the garden and grounds overgrown with weeds." But these circumstances had no effect upon him: there was a laundry which would serve as a library, and roomy stables which were just suitable for the grinding of mirrors, and a grass-plot where "the small twenty-foot" could be erected. Under such conditions the end of the introductory epoch of his life, as Prof. Holden expresses it, was reached: henceforth he lived in his observatory, rarely leaving it, from his forty-fourth year onwards, except for short periods to submit his classic memoirs to the Royal Society, and even selecting for such visits periods when moonlight interfered with the work of the telescope. We are told that much of his time was occupied, soon after he was settled at Datchet, in going to the Queen's Lodge, to show objects through the 7-feet reflector to the king and Court, but "when the days began to shorten, this was found impossible, for the telescope was often (at no small expense and risk of damage) obliged to be transported in the dark back to Datchet, for the purpose of spending the rest of the night with observations on double stars for a second catalogue."

In his paper entitled "An Account of Three Volcanoes in the Moon," communicated to the Royal Society in 1787, Herschel refers to previous observations of a similar kind, and Prof. Holden gives a translation of a letter written by Baron de Zach, from London, to Bode, the editor of the *Berliner Jahrbuch*, in which these observations are mentioned. An occultation of a star at the moon's dark limb was to take place on the evening of May 4, 1783, and was observed by Herschel and Dr. Lind, a physician in Windsor. Mrs. Lind also placed herself at a telescope to watch the phenomenon. "Scarcely had the star disappeared before Mrs. Lind thought she saw it again, and exclaimed that the star had gone in front of, and not behind, the moon. This provoked a short astronomical lecture on the question, but still she would not credit it, because she *saw* differently. Finally Herschel stepped to the telescope, and in fact he saw a bright point on the dark disk of the moon, which he followed attentively. It gradually became fainter, and finally vanished." . . . Zach professes to report what actually fell from Herschel's lips. Mrs. Lind's observation might be supposed to refer to the apparent projection of a star upon the moon's dark limb, of which we have other instances, but that after an astronomical lecture, however brief, Herschel should have looked into the telescope and still found the same bright point is hardly reconcilable with this explanation; and further if there was no misapprehension of Herschel's words on Zach's part, he seems to have ascribed the appearance to a lunar volcano.

In 1783 Herschel married a daughter of Mr. James Baldwin, a merchant of the City of London, and the widow of Mr. John Pitt; she was entirely interested in his scientific pursuits, and brought him a considerable jointure. Their only child was John Frederick William, born March 7, 1792.

Writing in 1783, Herschel says he had finished his third review of the heavens, which was made with the same instrument as the second, but with the power increased from 227 to 460. It extended to all the stars of Flamsteed's Catalogue, "together with every small star about them to the amount of a great many thousands of stars." He tells us of this third review, that he had "many a night, in the course of eleven or twelve hours of observation, carefully and singly examined not less than 400 celestial objects, besides taking measures, and sometimes viewing a particular star for half an hour together." The summer months of 1783 were occupied in energetic efforts to get the large 20-feet reflector ready for observations during the ensuing winter, and with success; the sweeps for the fourth review of the heavens were commenced before the end of the year. Caroline Herschel relates that at the end of 1783 her search for comets and nebulæ was interrupted to write down her brother's observations with the large 20-foot, and states that in the early use of so cumbrous an instrument and its appurtenances in the open air, she could give "a pretty long list of accidents" which were near proving fatal to her brother or to herself.

In the long days of the ensuing summer months many 10- and 7-feet mirrors were finished. Prof. Holden mentions that in 1785 the cost of a 7-feet telescope, six and four tenths inches aperture, stand, eyepieces, &c., complete, was 200 guineas, and a 10-feet was 600 guineas. A 20-feet telescope would cost from 2500 to 3000 guineas. Herschel made four 10-feet telescopes for the king, one of which was delivered in July, 1786, as a present from the king to the Observatory of Gottingen. Later a 7-feet telescope complete was sold for 100 guineas. For a 10- and a 7-feet telescope the Prince of Canino paid 2310*l*.

Prof. Holden reproduces a letter addressed to Bode about this time by De Magellan, which appeared in the *Jahrbuch* for 1788, from which we make one or two extracts. He writes:—"I spent the night of the 6th of January at Herschel's at Datchet, near Windsor, and had the good luck to hit on a fine evening. He had his 20-foot Newtonian telescope in the open air and mounted in his garden very simply and conveniently. It is moved by an assistant who stands below it . . . In the room near it

[1] Continued from p. 431.

sits Herschel's sister, and she has Flamsteed's Atlas open before her As he gives her the word she writes down the declination and right ascension, and other circumstances of the observation. In this way Herschel examines the whole sky without omitting the least part . . . He has already found about 900 double stars and almost as many nebulæ I went to bed about one o'clock, and up to that time he had found that night four or five new nebulæ The thermometer in the garden stood at 13° Fahrenheit, but in spite of this Herschel observes the whole night through, except that he stops every three or four hours and goes in the room for a few moments For some years Herschel had observed the heavens every hour when the weather is clear, and this always in the open air, because he says that the telescope only performs well when it is at the same temperature as the air . He has an excellent constitution, and thinks about nothing else in the world but the celestial bodies "

An account of the discoveries made with the 20-feet instrument and the improvements effected in its mechanical parts during the winter of 1785 is given with the catalogue of the first 1000 new nebulæ in the *Phil Trans* 1786 The house at Datchet being found to be more and more unfit for the requirements of the family, Herschel removed in June 1785 to Clay Hall in Old Windsor, but here "a litigious woman" for a landlady brought unlooked-for troubles, and on April 3, 1786, the house and garden at Slough were taken, and all apparatus and machinery immediately removed there "The last night at Clay Hall was spent," as Caroline Herschel records, "in sweeping till daylight, and by the next evening the telescope stood ready for observation at Slough " Here Herschel resided for thirty-six years, or from 1786 until his death As Arago has said of this spot, " On peut dire hardiment du jardin et de la petite maison de Slough, que, c'est le lieu du monde où il a été fait le plus de découvertes Le nom de ce village ne périra pas, les sciences le transmettront réligieusement à nos derniers neveux "

On January 11, 1787, Herschel discovered two satellites to the planet Uranus, and Prof Holden relates, before making known his discovery to the world, he satisfied himself by this crucial test he prepared a sketch of Uranus attended by his two satellites, as it would appear on the night of February 10, 1787, and when the night came " the heavens displayed the original of my drawings, by showing, in the situation I had delineated them, the Georgian planet attended by two satellites I confess that this scene appeared to me with additional beauty, as the little secondary planets seemed to give a dignity to the primary one, which raises it into a more conspicuous situation among the great bodies of the solar system." In the subsequent announcement of the discovery of four additional satellites of Uranus it is now generally conceded that Herschel was misled by minute stars his American biographer indeed conjectures that he may have seen *Ariel* on March 27, 1794, and *Umbriel* on April 17, 1801, but however this may be, the discovery of these satellites in the strict sense of the term is considered due to the late Mr. Lassell, who, from repeated observations, was enabled to assign their periods of revolution and mean distances from the primary

Herschel dates the completion of the celebrated 40-feet reflector from August 28, 1789, when he writes: " Having brought the instrument to the parallel of Saturn I discovered a *sixth* satellite to that planet, and also saw Saturn better than I had ever seen them before " On September 17 following a *seventh* satellite was discovered with the same instrument, of which we shall have occasion to say more, when we come to treat of the subjects included in Prof Holden's last chapter.

Although Herschel's relations with his contemporaries were usually of the most pleasant kind, there were several occasions upon which he appears to have been somewhat irritated by their comments respecting his work and writings, as in the case of the discovery, or rather supposed discovery, of mountains of great elevation upon the planet Venus, claimed by Schroter of Lilienthal, and described in a paper which appeared in the *Phil Trans.* for 1792 Herschel's memoir, "Observations on the Planet Venus," in the *Phil Trans* of the following year, is viewed by Holden as intended far more as a rejoinder for detractors at home than for the astronomer abroad At this time he considers there certainly existed a feeling that Herschel undervalued the labours of his contemporaries, an impression no doubt fostered by his general habit of not quoting previous authorities in the fields in which he was working · but he is nevertheless of opinion that "his definite indebtedness to his contemporaries was vanishingly small " The work of Michell and Wilson he always mentioned with appreciation Some annoyance may have been evinced that the papers of Christian Mayer, "De novis in cœlo sidereo phenomenis" (1779), and "Beobachtungen von Fixterntrabanten" (1778), should have been quoted to prove that the method which he had proposed in 1782 for determining the parallax of the fixed stars should not have entirely originated with himself, but his biographer affirms that in the Memoir of Caroline Herschel there is direct proof that it did so, and further it is shown in his Catalogue of Double Stars His proposal to call the minor planets detected by Piazzi and Olbers (*Ceres* and *Pallas*) *asteroids* also led to much criticism, and Prof Holden transfers from the first volume of the *Edinburgh Review* part of an article on the subject, as it is remarked, " simply to show the kind of envy to which even he, the glory of England, was subject "

In the Diary and Letters of Madame D'Arblay we find various personal reminiscences of visits paid to Herschel both by herself and Dr Burney between 1786 and 1799 In 1793 Herschel was a witness for his friend James Watt in the case of Watt *v.* Bull, tried in the Court of Common Pleas, and it appears that he visited Watt at Heathfield in 1810 In the "Life and Letters of Thomas Campbell," edited by William Beattie, is published a letter from the poet, describing his meeting with Herschel in September, 1813 "His simplicity, his kindness, his anecdotes," writes Campbell, "his readiness to explain—and make perfectly conspicuous too—his own sublime conceptions of the universe are indescribably charming. He is seventy-six, but fresh and stout; and there he sat, nearest the door, at his friend's house, alternately smiling at a joke, or contentedly sitting without share or notice in the conversation. Any train of conversation he follows implicitly; anything you ask he labours with a sort of

boyish earnestness to explain." Campbell relates that he was anxious to get from him as many particulars as he could, respecting his interview with Buonaparte, when First Consul, who, it had been reported, had astonished him by his astronomical knowledge. This interview must have taken place in 1802, his sister's Memoir recording that he left Slough on July 13 in that year to go to Paris, returning on August 25 with his son (who had accompanied him) dangerously ill The result of Campbell's inquiries was hardly confirmatory of the reports which were prevalent. "The First Consul," he said, "did surprise me by his quickness and versatility on all subjects; but in science he seemed to know little more than any well-educated gentleman, and of astronomy much less for instance than our own king. His general air was something like affecting to know more than he did know" There would seem to be no other record of this interview; Lalande, gossip that he was, has no reference in his notes for 1802 to Herschel's visit to Paris, though he, in common with other French astronomers, as Cassini, Mechain, Legendre, had visited at Slough, and might be supposed to be interested in Herschel's return-visit to the French capital In a letter to Alison, written in December, 1813, Campbell reverts to the pleasure which the day spent with Herschel had afforded him; in this letter he repeats it was "not true, as reported, that Buonaparte understood astronomical subjects deeply, but affected more than he knew"

The occurrences of the later years of Herschel's life are very briefly noticed by Prof Holden. All through the years 1814-1822 his health was very feeble. The severe winter of 1813-14 told materially upon him. In 1814 he attempted to re-polish the mirror of the 40-feet telescope, but was obliged to give up the work. He found it necessary to make frequent excursions for change of air and scene In December, 1818, he went to London to have his portrait painted by Artaud, and while there his will was made Particulars of the will appeared in the *Gentleman's Magazine* for 1822, p 650, the instruments, telescopes, observations, &c, were given, on account of his advanced age, to his son for the purpose of continuing his studies "It is not necessary to say how nobly Sir John Herschel redeemed the trust confided to him. All the world knows of his Survey of the Southern Heavens, in which he completed the review of the sky which had been begun and completed for the northern hemisphere by the same instruments in his father's hands" During the next three years the time he was able to spend in work was devoted to putting his papers in order, but he was daily becoming more and more feeble.

Herschel died on August 22, 1822, at the age of eighty-four years He was buried in the church of St Lawrence at Upton, near Slough, and a memorial tablet was placed over his grave with an epitaph which some have ascribed to the late Dr. Whewell, others to a Provost of Eton, with three lines from which we may close the present notice, reserving for a concluding article the consideration of the scientific labours of William Herschel, which forms the subject of Prof. Holden's last chapter.

> "*Novis artis adjumentis innixus*
> *Quæ ipse excogitavit et perfecit*
> *Cælorum perrupit claustra.*"

J. R. HIND

A POLAR RECONNAISSANCE

A Polar Reconnaissance: being the Voyage of the "Isbjorn" to Novaya Zemlya in 1879. By Albert H. Markham, F R G S., Captain R N. Maps and Illustrations (London: Kegan Paul and Co., 1881)

A "RECONNAISSANCE" in military parlance is, we understand, a preliminary to a serious attack in full force, and in this sense Capt. Markham evidently uses it in the work before us Had we any doubt of this, on a perusal of Capt Markham's story of his summer cruise, the preface by Mr. C R Markham would set that doubt at rest But indeed the whole tone of the volume bears on the resumption by Government of the search for the Pole, and Mr. Markham's preface is essentially a catalogue of the qualifications of the Captain for the command of an Arctic expedition. Apart from the questionable taste of this preface and the unpleasant feeling that the book as a whole has been written with a purpose, most of those who are competent to form an opinion will agree with us that in this direction Capt Markham's work is premature There is, we are glad to think, little chance of any Government Polar Expedition being sent out for a long time to come. No good could accrue to either science or navigation from an expedition similar to our last expensive failure, and even the additions to mere geography could be of the most trivial importance While we should be glad enough to see the whole of the Polar area explored, and to know whether the "apex of the world" is land or water, we are content to wait until polar problems of much greater scientific importance are solved The result of Sir George Nares's expedition has been to compel the enthusiasts on behalf of the Smith Sound Route to abandon it as hopeless, and seek for some other gateway to the Pole. In this it may be found they have been too hasty, for indeed our knowledge of the conditions of the Polar area is of the scantiest The expedition sent out in the *Jeannette* by Mr. Gordon-Bennett has been given up by many for lost; though we are glad to learn that the U.S Government have resolved to send out a search expedition Within recent years the route by Franz-Josef Land has become a favourite with many, though why this should be so it is difficult to fathom, seeing that we know scarcely anything about it. It was discovered six years ago by the Payer-Weyprecht expedition, and since then it has been twice visited—by the *Willem Barents* in 1879, and by Mr. Leigh Smith in his yacht last year. Mr. Smith, as we showed at the time of his return, did some excellent work, having traced the land to a considerable distance to the north-west He returns again next summer, and we trust he will be able to add still farther to our knowledge not only of the land itself, but of its physical and biological conditions, past and present. One or two enthusiasts who hail the discovery of a barren Arctic islet as if it were a new world, have rushed to the conclusion that Franz-Josef Land would form an excellent basis from which to storm the Pole. But we consider it useless to discuss the question. In a recent article we showed that in every country but our own scientific geographers have come to the conclusion that a mere search for the Pole is a wanton waste of resources, and that the only effective method of adding to our knowledge of the Polar area is by a series of observations continued over several years carried on at

permanent observing stations all round the Arctic region Preparations are now being actively made to begin this work next year, and before that time we trust our own Government will have seen it to be its duty to join the international scheme. If the Geographical Society really wishes to advance scientific geography, let it use its influence to promote this end, surely it has a higher conception of geography than that it consists of mere topography.

Leaving the purpose of Capt Markham's book out of account, it is very pleasant reading He did not break up any new ground, but he is a good observer, and has been able to make some fresh additions to what is already known of Novaya Zemlya and the neighbouring seas. He accompanied Sir H Gore Booth in the Norwegian cutter, the *Isbjorn*, from May to September, 1879 They sailed along most of the west coast of Novaya Zemlya, passed through Matotschkin Schar into the Kara Sea, and sailed down the east coast some distance, afterwards pushing northwards they reached to within 2° of Franz-Josef Land, which was all but touched by the *Willem Barents*, with which the *Isbjorn* had forgathered in the Schar Sir H Gore Booth's object was sport, and very good sport he had, both on the sea, the ice, and Novaya Zemlya Capt Markham made some useful observations on the movements of the ice, and brought home valuable collections in zoology, geology, and botany, which have been examined and arranged by a number of specialists, and printed as an appendix to Capt Markham's narrative He is really skilful in the use of his pen, and the story of his cruise is quite delightful reading Sir Joseph Hooker's account of the plants of the little expedition in the appendix is specially interesting "Comparing, then," he says, "the Floras of the three high Arctic meridians of Novaya Zemlya, lat 70°–77°, long E 60°, Spitzbergen, lat 76½°–80½°, long E. 20°; West Greenland and Smith's Sound, &c, lat 71°–82°, long W 60°–70°, we find that they present great differences, Greenland being the most remarkable—1 From the number of species of European types it contains which there reach so very high a parallel, 2 From differing more in its flora from Spitzbergen and Novaya Zemlya than these do from one another, and, 3 From the absence of Arctic *Leguminosæ*, *Caltha*, and various other plants that extend elsewhere around the Arctic circle These facts favour the conclusion which I have expressed in the Appendix to Sir G Nares's narrative (ii. 307), that the distribution of plants in the Arctic regions has been meridional, and that their subsequent spread eastward and westward has not been sufficient to obliterate the evidence of this prior direction of migration. To this conclusion I would now add, that whereas there is no difficulty in assuming that Novaya Zemlya and the American Polar islands have been peopled with plants by migration from the south, no such assumption will explain the European character of the Greenland, and especially the high northern Greenland vegetation, the main features of which favour the supposition that it retains many plants which arrived from Europe by a route that crossed the Polar area itself, when that area was under geographical and climatal conditions which no longer obtain."

There are several very good and apparently new illustrations of scenery in Novaya Zemlya, evidently from photographs, and two useful maps.

OUR BOOK SHELF

Contributions to the Agricultural Chemistry of Japan By Prof E. Kinch. (*Trans* Asiatic Soc. of Japan, 1880.)

THIS interesting and valuable paper opens with an historical survey of the question "Is the soil of Japan generally fertile?" The observations of former travellers and the evidence of recent investigators are used in order to show how far the productiveness of Japanese soils is due to natural *fertility*, and how far to artificial *condition*, using these terms in the agricultural senses usually attached to them in England. Prof Kinch has collected some analyses of Japanese rocks made by various authorities, and has supplemented them by analyses of nine soils The results, so far as nitrogen and immediately available phosphoric acid and potash are concerned, do not point to any high degree of natural fertility. Passing from the soil-question to that of manures, he gives analyses of fossil shells and of various vegetable ashes employed for enriching the land. An examination of crude nitre yielded 56·5 per cent of pure potassium nitrate The Japanese use certain leguminous plants for green manuring, they also employ as manure the cakes of oil-seeds, malt dust from rice, millet, and barley, the residues from the manufacture of rice-beer and soy, and the "cleanings" of rice-grain Analyses of these materials have been made by Mr Kinch. A waste product obtained in the manufacture of indigo was found to contain about 3 per cent of potash, 5·75 per cent of phosphorus pentoxide, and nitrogen equal to 1·70 per cent. of ammonia.

After a few remarks on fish manures and the composition of the sweepings from barbers' shops, Mr Kinch turns to the subject of Japanese foods. The "glutinous" rice was found to differ from common rice mainly by containing *less* gluten—only 5·1 per cent. instead of 6·1—both figures being extremely low for a main article of diet In this particular three kinds of Japanese millet gave more favourable figures, about 12 being the average percentage of gluten or flesh-formers.

Mr Kinch has examined the soy bean and its chief products with care A white round variety of this leguminous seed gave no less than 21 per cent of fat and nearly 38 per cent. of albuminoids or flesh-formers. The seeds of *Phaseolus radiatus* contained about ½ per cent. of fat and 18 per cent. of albuminoids The gigantic radish of Japan much resembles the common turnip in composition, and contains 95 per cent of moisture. The analyses of seaweeds eaten in Japan are numerous, and furnish some interesting facts concerning an important source of food greatly neglected in Europe A few details concerning the waters of Japan and certain matters relating to the silk industry conclude a paper which, though it is of necessity unsystematic and imperfect, yet contains a large amount of condensed and useful information about the chemico-agricultural subjects which the author discusses.

A. H. C.

Experimental Chemistry for Junior Students. By J. Emerson Reynolds, M.D, F.R.S. Part I. Introductory. Pp. 142 (London Longmans, Green, and Co., 1881.)

THE aim and the plan of this little book clearly mark it out among the numerous small treatises on practical chemistry which flow in such a steady stream from the press. The aim is to teach a beginner in chemistry the leading principles of the science by a graduated course of experiments which he is himself to perform; the plan is to begin with the fundamental differences between chemical and mechanical action, and to lead the experimentalist on to the laws of definite proportion, and of general chemical action. Quantitative experiments are introduced at an early part of the course; those chosen seem to be well suited for the fulfilment of the author's

aim, being fairly easily conducted, and at the same time definite and trustworthy in their results.

The principal chemical differences between metals and non-metals are illustrated by experiments on hydrogen and oxygen; the meaning of the terms "acid," "base," "salt," &c., are clearly demonstrated by experimental evidence. The clearness of the enunciation of the fundamental assumptions of the modern atomic theory; the method, experimentally illustrated, of determining molecular and atomic weights; the experimental proof of the splitting of elementary molecules in chemical changes; the method of determining the atomic heat of a metal; the proof of the gaseous laws; the determination of the volume of unit weight of hydrogen, and the application of this determination to the calculation of the weights of gaseous volumes generally; these and other experiments and deductions are all admirably described.

The author is certainly to be congratulated on the production of this book; the care and trouble bestowed on it are doubtless not to be measured by the small number of pages which it contains; the result is most satisfactory. No better guide to the study of chemical science could be placed in the hands of the beginner than this modest little volume of Prof. Reynolds'. M. M. P. M.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Barometric and Solar Cycles

I SEE that Prof. Hill regards the barometric evidence as favourable to the hypothesis that the sun is most powerful when there are fewest spots on his surface. Perhaps I may therefore be allowed to state the reasons which have induced me to entertain a contrary opinion, which are, I imagine, the same as have also occurred to others. I quite agree with Prof. Hill that the true relation between the variations of sun-spot area and barometric pressure will ultimately be discovered by means of the admirable weather-maps of the United States. Nevertheless, we must wait until these have been produced in sufficient number before we attempt to generalise.

I do not think therefore that Prof. Hill is warranted in drawing any conclusion from a single map, however important, such as that for July, 1878—a time of minimum sun-spots.

Referring to your article (NATURE, vol. xxi. p. 567), I find the evidence from this map to be summarised as follows:—

"It may be worth remarking that this increased pressure over the oceans and diminished pressure over the land of the northern hemisphere is in accordance with what might be expected to result from an increased solar radiation; whilst on the other hand the increased pressure over Southern and Central Asia, and diminished pressure in the southern hemisphere, is not in direct accordance with this supposition."

It thus appears that this evidence is after all of a very mixed nature.

Regarding the unequal distribution of barometric pressure as without doubt caused by the sun, we may with much justice imagine that whenever the sun is most powerful these peculiarities of distribution will be greatest and most apparent. If we now look at a map of isobaric lines (Buchan, "Handy Book of Meteorology") we shall find that the Indo-Malayan region is one that for the mean of the year has a barometric pressure probably below the average. Now during years of powerful solar action we should imagine that this peculiarity would be increased. But this is precisely what all the Indian observers have found for years with most sun spots. On the other hand, Western Siberia in the winter season has a pressure decidedly above the average, and we should therefore imagine that during years of powerful solar action the winter pressure in Western Siberia would be particularly high. This again is the state of things that Mr. Blanford has found in his discussion of the Russian stations (NATURE, vol. xxi. p. 479) to correspond with years of most sun spots.

It therefore appears that the barometric evidence, as far as it goes, is favourable to the belief that years of maximum sun spots are years of greatest solar power. BALFOUR STEWART

Bi-Centenary of Calderon

I AM requested by H. E. Don A. Aguilar, Secretary-General of the Royal Academy of Science of Madrid, to beg you will have the goodness to insert in your journal the inclosed notice from that body, offering a prize for an essay on the works of Calderon de la Barca. I am aware that the other Academies (History and Spanish) have already offered prizes for similar works, but this being intimately associated with science, the Academy in that branch has thought it desirable to offer a separate and special one.

I trust I may count on your kind hospitality for a foreign colleague if not trespassing too far on your valuable space.

F. J. RICARDE-SEAVER

Conservative Club, St. James Street, S.W., March 11

ROYAL ACADEMY OF SCIENCE, MADRID

Programme (adopted by the Council) for the adjudication of a Prize in Commemoration of the Bi-centenary of Calderon de la Barca, 1681, May 25, 1881

The Royal Academy of Science of Madrid being desirous amongst others of commemorating the bi-centenary of the great Spanish dramatic poet Don Pedro Calderon de la Barca, offers a prize for public competition on the following theme:—

"The conception of Nature and her laws deducible from the works of Calderon, as the expression of the standard of scientific knowledge amongst individuals at that period who, without specially professing science, excelled in the cultivation of letters. An analysis of the works of contemporary poets in support of their theme being optional with competitors."

Conditions.

Article 1.—The author of the successful essay will receive a prize consisting of a bronze medal with the legend of the Royal Academy of Science and the sum of 500 pesetas (20*l.*), as also 200 copies of the prize essay printed and bound at the cost of the Academy.

Article 2.—The competition shall remain open from this date up to the 10th May next.

Article 3.—The essays must be written in Spanish or Latin.

Article 4.—These must be delivered or forwarded to the Secretary of the Academy (H. E. Don A. Aguilar, 2, Plaza de la Villa, Madrid) before the above date, with a distinctive endorsement on the outer cover, so as to be easily recognised, but without further notes or indication whatever.

Accompanying the essay the author must transmit a *sealed* letter bearing the same endorsement as the essay itself, and containing *inside* the name and address of the author.

Further conditions may be learned from

A. AGUILAR, Secretary-General

2, Plaza de la Villa, Madrid, February 12

The Photophone

THREE years ago, whilst experimenting on the action of radiant heat and light on the electrical resistance of substances, I was induced to believe that coating selenium with varnish or lamp-black would largely increase its sensibility to light. I therefore annealed a stick of selenium about 2 cm. in length and 5 cm. in diameter, having previously melted into each end a platinum wire, and thus obtained a specimen which, though of very high resistance, was exceedingly sensitive to the action of light. The effect of diffused daylight was tested in the following manner:—The specimen was placed in a glass box and connected directly with two Leclanché cells and a very delicate Thomson's galvanometer having a resistance of 6000 ohms; a deflection of, as far as I now remember, about 300 divisions of the scale was produced, and the light was then brought to zero by means of the adjusting magnet; a dark blind which had previously been drawn down was now pulled up, and the result was a deflection of about 100 divisions in the same direction as before. The glass box was placed three yards in front and a little to one side of the window, which was closed, and the sun at the time (about 4 p.m. July, 1877) was on the other side of the house. The

selenium was then coated with shell-lac varnish, and about two hours afterwards again tested in the same manner as before, when the light was found to produce a deflection of 220 divisions, or more than *twice* the previous amount. The action of radiant heat was similar to that of light in the case of this particular specimen, but I have little doubt that *any* specimen may be rendered more sensitive to light by coating it with varnish or lampblack. I hope that this suggestion will prove of service to those philosophers who may aspire to "hear a beam of light" or to "see by electricity," and shall be glad to hear that such has been the case HERBERT TOMLINSON

King's College, Strand, March 7

Cave Animals and Multiple Centres of Species

THE readers of Semper's "Existenzbedingungen der Thiere," now translated into English, will find (vol ii p 268 of the German edition) an interesting discussion on the question of monophyletic or polyphyletic evolution of species, the author decidedly inclining to the latter hypothesis. Considering that at the root of the manifold and difficult problems here involved, there is the relatively simple one of single or multiple centres of each species in a biographical sense, I take leave to ask the following question, hoping for an answer from among your readers versed in these matters.

To me it seems impossible to maintain the single centres of species *in a strict and definite sense without also maintaining the* single progenitor of each species, which latter view, formerly considered as a necessary assumption, has been given up by Mr Darwin in Chapter IV. of the later editions of the "Origin of Species" (5th ed p. 103, 104) Of course the acceptance of single centres, in the sense of more or less restricted areas of origination, may remain valid for the vast majority of species—but this is very different from considering it, once for all, as "a necessary consequence of the adoption of Darwinian views," as has been formerly said by Mr. Bentham (NATURE, vol ii p 112)

Now, I have sometimes thought that there might be a test for the *possibility* of multiple centres, which, eventually, would amount almost to an experimental demonstration—namely *whether there are cases of the same species of blind animals occurring in different caves distant from and without subterranean communication with each other?* Should such cases occur it would be most improbable that the animals in question had been transported from one cave to the other in the modified state, and most probable that they had been independently evolved in each cave from identical species which entered it from without I formerly noted one instance perhaps in point, viz. a statement of Prof Cope's (NATURE, vol. vii p 11) that "the blind fish of the Wyandotte Cave is the same as that of the Mammoth, the *Amblyopsis spelaeus*, Dekay," but I am not aware whether subterranean communication is, or has been, impossible in this instance Perhaps more decisive cases have become known of late?

Freiburg im Breisgau, March 4 D WETTERHAN

Prehistoric Europe

WILL you kindly allow me to correct a clerical error in my letter which appeared in NATURE, vol xxiii p 433 For "'hash-up' of *the* species," read "'hash-up' of species" A number of the species from the Upper or Interglacial Bone-bed of Mont Perrier (and some of which are mentioned in my letter) are of course too characteristically Pleistocene to be claimed by Prof Dawkins as Pliocene forms, and do not therefore appear in his list of Upper Pliocene species to which I referred.

Perth, March 14 JAMES GEIKIE

Measuring the Height of Clouds

IN NATURE, vol xxiii. p. 244, Mr. Edwin Clark gives a method whereby the height or distance of clouds may be measured. This end has already been attained by me, several years ago, and I believe with adequate success I have also worked out the method in detail, so that its practical realisation no longer offers any difficulty. It is very simple and easy, and the apparatus ("nephoscope") is not difficult to make A full description of the nephoscope will be found in the *Zeitschrift der Oesterreich Ges. fur Meteorologie*, edited by Jelinek and Hann, vol. ii. p. 337, in so far as the instrument serves for measuring the *direction and velocity* of the passage of clouds. In order also to ascertain the *absolute height* of clouds (N B all without calculation) I have introduced an improvement. This and a guide to practical use I have published in the same *Zeitschrift* (vol. ix September, 1874, pp 257-61) I believe Mr. Edwin Clark will find in the article referred to his idea fully worked out.

C. BRAUN,

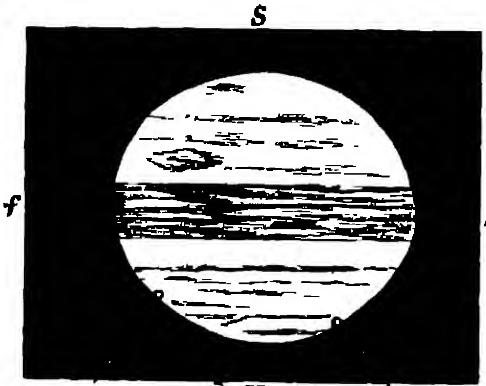
Kalocsa, Hungary, March 3 Director of the Observatory

Occultation of 73 Piscium

I OBSERVED here this evening the occultation of 73 Piscium by Jupiter, which was predicted in your "Astronomical Column" under the date December 23, 1880 (NATURE, vol xxiii p 183). At 1h 52m 30s G M.T the star was hanging on the limb of the planet, and by 1h 54m it had entirely disappeared.

The phenomenon strongly resembled the occultation of a satellite, except that the disappearance was more rapid But it was not instantaneous as I had expected The planet and star appeared to cohere for about one and a half minute. The contrast in their colours was very marked, Jupiter appearing of a yellowish tinge, while the star shone out white like a diamond. During the occultation the red spot was on the planet's disk, and its following end was in about the same meridian as the point of the star's occultation.

I had no micrometer, but I inclose a diagram showing the estimated points of occultation and reappearance.



The G M.T. of reappearance was 2h. 44m., when the star was again observed to hang on to the planet's limb

The telescope used was a 4¼ inch refractor by Cooke equatorially mounted, with a power of 96.

The planet was well placed for observation, being nearly in the zenith

Before and after the occultation Jupiter appeared as if with five moons, the star being almost indistinguishable from the satellites

As the occultation could not be observed in Europe these few notes may possibly prove of some interest

A diagonal (prism) eyepiece was used in making the sketch.

Meean Meer, Lahore, February 3 H. COLLETT

Colours of British Butterflies

MOST of the protectively coloured British butterflies pair either on the ground as the "Blues," or on low herbage as the majority, or on the leaves of trees, as some of the "Hair-streaks," and with closed wings The wings of both sexes are usually opened as widely as possible immediately before copulation.

I have been struck by the fact, which I may mention in reference to the remark of Mr. J. Innes Rogers (NATURE, vol. xxiii. p. 435), that I have never seen the "peacock" attacked by any British bird, and I have often watched him flaunting his colours in the presence of shrikes, flycatchers, and other—one would imagine dangerous—company. W. CLEMENT LEY

Ashby Parva, Lutterworth, March 11

Lecture Representation of the Aurora Borealis

I HAVE recently employed a simple device for giving to an audience a vivid idea of an aurora, and that has been to paint a

representation of it with Balmain's luminous paint. When dry the drawing may be hung up in the lecture-hall and covered with black tissue-paper until required At the appointed time the lights are lowered, the tissue paper withdrawn, and magnesium wire burnt in front of the painting. I had last week the pleasure of showing this to an audience of 500 persons, and from the expressions of curiosity and approval found it to be a very taking experiment. WM. ACKROYD

Sowerby Bridge, March 10

Squirrels Crossing Water

HAVING read in NATURE the two interesting communications on Squirrels Crossing Water, I was so free as to cite them in my paper *Lumír*, requesting the readers to let me know whether any of them had seen instances of squirrels taking to water here in Bohemia. Upon this I received from my friend Prof A Tiráseh of Litomysl the following —

"You seem to doubt of squirrels taking to water, and I hasten to give you notice of what I myself witnessed when a boy With the help of other young fellows like myself I succeeded in driving a squirrel down from an old ash-tree that stood in our garden, not far from the River Medhuje (Metan) The squirrel must have come from the other side of the water, where there was a wood, and must have crossed the river. Of this however I cannot be sure, but when driven down from the tree, and seeing its way to landward cut off, the squirrel turned to the river, and sprang in, I following it. Now it swam very cleverly, but was overtaken by me in the middle of the water, and brought back in triumph, of course with my hands all bleeding from its sharp teeth, which the animal used cleverly too."

Prague, March 13 T V SLÁDEK

Tacitus on the Aurora

THERE is a passage in the "Germania" of Tacitus (chapter xlv.) which I do not think can have ever been examined by the historians of natural science, or it would have created a considerable stir amongst them Side by side with a plain account —probably the earliest written one—of an arctic twilight, there lurks in it a description of the aurora borealis, which moreover lends countenance to the still prevailing notion that the northern lights are accompanied by sound

Speaking of the Suiones, a tribe on the northern borders of Germany, the great writer says —"Beyond them is another sea, calm even to stagnation, by which the circle of the earth is believed to be surrounded and confined, because the last gleam of the setting sun lingers till he rises again, and so brightly that it dims the stars. It is believed too that a sound is heard, that the forms of gods and rays from a head are seen (persuasio adjicit sonum audiri insuper formas deorum et radios capitis adspici) Up to that point [however]—and the report [I have given] is true—everything is natural."

As to the question of sounds being heard, the din of carts and factories in our city, and the roar of trains in our suburbs make an observation here for determining it impossible; while the rarity of the phenomenon in England generally keeps spectators from being on the watch But I have heard an intelligent old man who has often gazed on the bright streamers during the clear still nights of Aberdeenshire declare that he has plainly observed sharp switching sounds to proceed from them It seems to me probable, since electricity can change into sound and takes part in producing the aurora, that the spectacle is attended by audible vibrations. M. L. ROUSE

Chislehurst, Kent

ON THE PRACTICABILITY OF LIVING AT GREAT ELEVATIONS ABOVE THE LEVEL OF THE SEA[1]

"UP to this time most of the loftiest portions of the earth are totally unexplored, and this arises principally from the fact that the mountaineer, in addition to experiencing all of the troubles which occur to other travellers, has to deal with some which are peculiar to his work. I do not now refer to the 'distressing hæmorrhages,' 'alarming vomitings,' and 'painful excoriations' which are said to afflict him Hæmorrhage and excoriation are rather large words, and they are apt to be alarming if they are not translated But they do not seem so very formidable if they are rendered 'bleeding at the nose' and 'loss of skin through sunburn', and it may perhaps tend still further to allay alarm if I say that I have never known bleeding at the nose to occur upon a mountain except to those who were subject to the complaint; while with regard to vomitings, although such unpleasant occurrences *do* happen, they have only been known when persons have taken that which has disagreed with them.

"There is, however, behind these, another trouble, which cannot be dismissed so lightly All travellers, without exception, who have ever attained to great altitudes, have spoken of having been affected by a mysterious complaint, and this complaint is known to affect native races living in high mountain regions, as well as casual travellers With us it is usually called mountain sickness There are many native names for it, and numerous conjectures have been put forward as to its cause Very commonly it is supposed to be the work of evil spirits, or mysterious 'local influences', but there is no doubt that it is simply an effect which is the result of the diminution in the atmospheric pressure which is experienced as one goes upward The reduction which takes place at great heights is quite sufficient to account for disturbance of the human system At 20,000 feet pressure is less than half the amount that it is at the level of the sea, that is to say, whereas at the level of the sea atmospheric pressure is generally capable of sustaining a column of mercury of thirty inches, at 20,000 feet it will not sustain a column of fifteen inches. * * * * *

"From air-pump experiments, and from purely philosophical considerations, it is obvious that the human system must be liable to derangement if subjected to sudden diminution of the atmospheric pressure to which it has been accustomed These disturbances have often been so severe as to render mountain travellers incapable, and their lives well-nigh unendurable, and it is scarcely to be wondered at that they have endeavoured to escape from the infliction by descending into lower regions. I do not know a single instance of a traveller who, having been attacked in this way, has deliberately, so to speak, sat it out, and had a pitched battle with the enemy. Nor am I aware that any one has even suggested the bare possibility of coming out victorious from such an encounter Yet, upon doing so, depended the chance of pushing explorations into the highest regions of the earth; and I long felt a keen desire to know whether my own organisation, at least, could not accommodate itself to the altered conditions From considerations which would occupy too long to enter into now, I gradually acquired the conviction that patience and perseverance were the principal requisites for success, and the journey of which I am now going to speak was undertaken with the view of bringing this matter, amongst other things, to a definite issue. In the course of it we camped out at very great heights Twenty-one nights were spent above 14,000 feet above the level of the sea, eight more above 15,000 feet; thirteen more above 16,000 feet; six more above 17,000 feet, and one more at 19,450 feet. I shall not now anticipate what you will presently hear, and I have made these preliminary observations to render less frequent the interruption of the narrative, and for the purpose of explaining allusions in it which might otherwise perhaps have been only half-understood"

After describing the route taken to Chimborazo, Mr. Whymper proceeded to mention the first journey he made to that mountain; and said that whilst returning from it to the town of Guaranda (8870 feet), whilst still about 13,000 feet above the sea, he was overcome by dizziness, feverishness, and intense headache, and had to be supported by two of his people for the greater part of the

[1] Extracts made, by permission of the author, from a lecture delivered by Edward Whymper to the Society of Arts in the Theatre at South Kensington, March 9, 1881—"On Chimborazo and Cotopaxi"

way "Imagining that I was attacked by fever, I took thirty grains of sulphate of quinine in the course of the night, and was covered up with a mountain of blankets; but next morning there was nothing the matter, and as the symptoms were precisely those which occurred at a later period, when we were *evidently* affected by low atmospheric pressure, I ultimately concluded that it was through this that the indisposition was caused

"At this point allow me to say a few words further with regard to the troubles which occur to persons who get to great altitudes Although the heights of the Andes which we were about to visit had not been well determined, there was reason to believe that several of them approached, if they did not exceed, 20,000 feet At the time of our departure there were only three tolerably well-authenticated instances of persons having reached that height on land, and I could learn nothing whatever which was of the least service respecting the experiences of those who were engaged in those expeditions But from others, who had reached altitudes of from 17,000 to 18,000 feet, I heard a confirmation of my supposition that, at such great elevations, I ought not to expect a continuance of the immunity from mountain sickness which I had hitherto enjoyed

"I made up my mind, therefore, before we left, that, sooner or later, we should suffer like the rest of the world, but, being of opinion, as I have already said, that patience would overcome mountain sickness, it was my intention, on all our expeditions, first to establish camps as high as we could force the natives and mules As it would be impossible to retain the natives at those positions, it became necessary to provide ourselves with food sufficient for weeks, or even for months, so that, in the event of our failing in our enterprises, either from badness of weather, mountain sickness, or other causes, we should not have the mortification of being obliged to abandon our positions simply from want of sustenance"

Mr Whymper then described the establishment of his second camp on Chimborazo at the height of 16,500 feet above the level of the sea, and said, "Although we had succeeded in establishing our camp on the selected spot, it had only been done by the greatest exertions on the part of my people and their beasts The mules were forced up to the very last yard that they could go, and staggering under their burdens (which were scarcely more than half the weight they were accustomed to carry), stopped repeatedly, and by their trembling, falling on their knees, and general behaviour, showed that they had been driven to the verge of exhaustion When we arrived at the second camp, we ourselves were in good condition, which was to be expected, as we had ridden up the entire distance from Guaranda, but within an hour I found myself lying on my back, along with both of the Carrels, placed *hors-de-combat*, and incapable of making the least exertion We knew that our enemy was upon us at last, and that we were experiencing our first attack of mountain sickness

"We were feverish, had intense headaches, and were unable to satisfy our desire for air, except by breathing with open mouths This naturally parched the throat, and produced a craving for drink, which we were unable to satisfy, partly from the difficulty of obtaining it, and partly from the difficulty of swallowing it For, when we got enough, we were unable to drink, we could only *sip*, and not to save our lives could we have taken a quarter of a pint at a draught Before one-tenth part of it was down, we were obliged to stop for breath, and gasp again, until our throats were as dry as ever Besides having our normal rate of breathing largely accelerated, we found it impossible to get along, without every now and then giving a spasmodic gulp, just like fishes when they are taken out of water. Of course there was no desire to eat; but we wished to smoke, and found that our pipes almost refused to burn, for they, like ourselves, wanted more oxygen.

This condition of affairs lasted all night and all the next day, and I then managed to pluck up spirit enough to get out the chlorate of potash, which, by the advice of Dr Marcet, I had brought in case of need. Chlorate of potash was, I believe, first used in mountain travel by Dr Henderson, in the Karakorum range, and it was subsequently employed on Sir Douglas Forsyth's Mission to Yarkand in 1873-4 The surgeon to the expedition states that he distributed little bottles of it amongst the members of the embassy, and says that, from his own experience, he can testify to its value in mitigating the distressing symptoms produced by a continued deprivation of the natural quantity of oxygen in the atmosphere. Before my departure, Dr. Marcet urged me to experiment, with the view of confirming these experiences. Ten grains to a wine-glass of water was the dose recommended, to be repeated every two or three hours if necessary. I say distinctly that I *thought* it was of use, though it must be admitted it was not easy to determine, as one *might* have recovered just as well without taking any at all Anyhow, after taking it the intensity of the symptoms diminished, there were fewer gaspings, and in a degree a feeling of relief I am so far in favour of its use, that I shall always carry it on future expeditions Louis Carrel also submitted himself to experiment, and seemed to derive benefit, but Jean Antoine, the elder of the two, sturdily refused to take any doctor's stuff, which he regards as an insult to intelligence * * * * * *

"It seems curious to relate that Mr Perring (interpreter) did not appear to suffer at all. Except for him we should have fared somewhat badly He kept the fire going—no easy task, for the fire appeared to suffer from want of oxygen just like ourselves, and it required such incessant blowing that I shall consider for the future a pair of bellows an indispensable part of a mountaineer's equipment Mr Perring behaved on Chimborazo in an exemplary manner. He melted snow, and brought us drink, and attended to our wants in general. It goes, therefore, somewhat against the grain to say that he had been for a number of years in Ecuador much addicted to pursuits which play havoc with the human frame He was so far debilitated that he could not walk a quarter of a mile on a flat road without desiring to sit down, or 100 yards on a mountain side without being *obliged* to rest Had I been aware of his previous history, he certainly would not have accompanied us

"You will naturally inquire—How can you account for this man, of shattered constitution (who also was no mountaineer) being unaffected, when the three others, who where all more or less accustomed to high ascents, were for a time, completely incapable? The explanation appears to be this. Perring had been for a long time residing in the interior, at heights of from 9000 to 10,000 feet, and had several times passed backwards and forwards over the Arenal, a height of over 14,000 feet. The mean elevation at which he had resided during the previous ten years was, in all probability, much higher than the mean elevation at which we others had lived, and it would probably have been found, had he been subjected to examination, that his manner of respiration, and even his organs of respiration, had become better adapted to a pressure of 16½ inches, which was the height of the mercurial column at our second camp" * * *

Mr Whymper and his Italian mountaineers remained in the same condition for several days At length the Carrels, becoming better, were eager to be off exploring, and they were sent upwards to find a higher camping place "They returned soon after dusk, both extremely exhausted. They could scarcely keep on their legs, and threw themselves down and went to sleep, without eating or drinking. Their condition, and the report which I heard next day, rendered it certain that our second camp, as a

starting-point, was not placed high enough. It appeared that the Carrels, neglecting their instructions, had made a push towards the summit, but had reached a height of only about 19,000 feet. As they were quite unencumbered, carrying no instruments, and only enough food for their own use, and had no traveller to look after, and yet came back quite exhausted, it was obvious that we should have to get still higher up before we could make a serious effort to reach the summit. So, as soon as he was well enough, I sent Louis with Perring down to the first camp to fetch up a tent, which had been left there, and when this arrived we were in a position to go forward again.

"On the following morning I went myself up the ridge to look for a higher camping place, and found one on the eastern side on some broken rocks, at a height of 17,400 feet. By this time I was in rather better condition than the Carrels. Feverishness had disappeared, and my blood had resumed its normal temperature. The gaspings had entirely ceased, and headache had gone. You will perhaps inquire how I knew that I was feverish, for in regard to this matter one is often mistaken, and fever is supposed when it does not exist. By the advice of the distinguished physician whose name has been already mentioned, Dr. Marcet, I had provided myself with a registering clinical thermometer for the purpose of taking blood temperature at great elevations. This was duly done, and in respect to this matter nothing more need be said than that at our greatest heights the temperature of the blood was (just as it is at the level of the sea) higher during periods of warmth, and lower when it was unusually cold, but stood at its normal height, when the thermometer was at 60° or thereabouts, and did not appear to be affected by low atmospheric pressure at all. In recommending me to take this little instrument (which I have in my hand), Dr. Marcet rendered me a great service, and amongst all the devices and instruments which have been pressed upon the attention of travellers in general, of late years, I know nothing equal to it in importance. By constant observation, I was able to detect the earliest advances of fever, and by taking proper steps in time, was able to get through the entire journey without having an attack of fever worth mentioning. Its expense is trifling, and it can easily be carried in the waistcoat pocket. When we were first laid on our backs by mountain sickness, it showed that my blood temperature mounted to 100°.4, but by the end of the year it had fallen to its usual height, viz., 98°. Still, although the more disagreeable symptoms had gone, we found ourselves remaining comparatively lifeless and feeble, with a strong disposition to sit down when we ought to have been moving." * *

Mr. Whymper then described his first ascent of Chimborazo, and concluded his account of this mountain by saying, "My residence on Chimborazo thus extended over seventeen days. One night was passed at a height of 14,400 feet, ten at a height of 16,500 feet, and six at 17,300 feet. During this time, besides ascending to the summit, I also went three times as high as 18,500 feet. When we quitted the mountain, *all trace of mountain sickness had disappeared*, nor did it touch us again until we arrived at the summit of Cotopaxi. * * *

"The height of Cotopaxi is 19,600 feet. Our camp was placed about 130 feet below the loftiest point, and it was the most elevated position at which any of us had ever slept. We remained there twenty-six consecutive hours, feeling slightly at first the effects of low pressure, having the same symptoms as we had noticed on Chimborazo, and we used chlorate of potash again with good effect. All signs of mountain sickness had passed away before we commenced the descent, and *they did not recur again during the journey*. * * * * *

"This, ladies and gentlemen, nearly brings my remarks to a close, and, in conclusion, permit me to say a word more in respect to mountain exploration in general. Amongst certain persons it is still fashionable to affect a description of scorn, bordering on contempt, for anything in connection with mountains and mountain work. None of us feel, perhaps, very deeply the criticism of those who are evidently ignorant of the subjects on which they talk; and, in this matter, speaking for myself, I rather look forward to the time, which will surely come, when the study of mountains, the ascent of mountains, and even prolonged residence on mountains, will be found essential for the prosecution of a score of sciences. Before this could be carried out, it was necessary to learn whether life could be made endurable at great heights. We were always haunted by the fear of an invisible enemy who might strike us down at any moment. What we wanted to know was, not whether life could exist at a height of 20,000 feet (that was settled seventy-five years ago, by Lussac), but whether man could become so far habituated to the low pressure which is experienced at that height, as to be able to live without inconvenience, and to do useful work. I went to the Andes in search of an answer to these questions; you have heard the story, and can form an opinion whether it affords encouragement for the prosecution of exploration in other quarters."

ON SOME POINTS RELATING TO THE DYNAMICS OF "RADIANT MATTER"

As the important researches of Mr. Crookes may be said to have made the evidence of the molecular state of matter (grounded on indirect reasoning) almost ocularly visible—the mechanics of gaseous matter therefore acquires a fresh interest. As some years back the present writer devoted much thought to the clear realisation of the nature of the motions of the molecules of gases in connection with a proposed explanation of the mode of propagation of sound on the basis of the kinetic theory (published in the *Philosophical Magazine* for June, 1877), it then appeared to him that the systematic *regularity* of the motions of the molecules of gases was not in practice so generally appreciated as it might be, although of course the mathematical basis of the subject was well established. It has been not unusual to speak of the extreme "irregularity" of the normal motions of gaseous molecules—which is undoubtedly true of any molecule taken individually. The comparison of the molecules of a gas to a "swarm of bees" (sometimes adopted), though no doubt highly convenient and useful to aid the conceptions in some respects, has probably gone to support (rather than not) the idea of a kind of confusion in the motions of the constituent molecules of gases, whereby the systematic *regularity* (or symmetry of the motion) tends to be left out of view. This will perhaps appear more evident if I state the following proposition in regard to a gas, which is only a direct corollary from the established mathematical principles—true in every state of the gas, but emphasised by rarefaction.

The normal motion of the molecules of a gas takes place in such a way, that every point in the gas is a "radiant point," such that matter passes to and from that point (to a certain distance) in the direction of rays, i.e. as if a luminous point were situated at the point in question. Or more generally put: If finely subdivided matter be in motion in space according to its own dynamics, every point of space becomes a radiant point, the extent of the radiation of matter depending on its fineness (other things being equal).

It is, I believe, the losing sight of the systematic regularity (or symmetry) of the motion of the molecules of a gas in its normal state, which (as it would seem, at least) has caused the connection of gaseous motion with the conditions for gravity to be overlooked—or the fact to escape realisation that on rarefying the gas, this symmetry of motion (existing in the normal state of the gas) gradu-

ally merges, without break of continuity, into the radiant streams of matter moving in the right directions to produce gravity under Le Sage's sheltering principle, without the necessity for adopting any of his postulates as to *direction* of motion, or assuming a *supply*[1] of matter from ultramundane space in continuous currents ("ultramundane corpuscles") As this subject was carefully thought out and dealt with by me in the *Philosophical Magazine* for September and November, 1877, &c, I may perhaps claim some right to say a few words about "radiant matter."[2]

The immense importance—in its possible practical applications—of this remarkable self-correcting principle (directly based on the mathematical results of the kinetic theory) whereby particles of matter, left to their own dynamics, rigidly adjust their motions so as to move in a "radiant" manner [and to return energetically to this beautifully symmetrical kind of motion when after disturbance they are left to themselves], has, I venture to think, not been duly appreciated For, looking at the case broadly, it would seem that this dynamical principle is capable of affording a means for substantially satisfying at least three fundamental objects in nature For, firstly, it will appear evident that we can have thereby a means perpetually present in every point of space for *carrying* energy in a "radiant" manner (*i e.* in the direction of the rays of light from a point) in all possible directions. Secondly, by this automatic system we can have a mechanism capable of causing (under the sheltering principle of Le Sage) the *approach* of the molecules of gross matter at any point of space—such as exhibited in the phenomena of "gravity" and (under modifying conditions probably) the other phenomena of approach, "cohesion" and "chemical action." Thirdly, since the "radiant" character of the motion is inevitably attended by an exact balance of the momenta at every point of space, we can have in this system an exhaustless store of energy in perfect equilibrium (and therefore concealed in its normal state), competent to throw some rational light on such unexplained phenomena as explosions, combustion, or the violent developments of motion taking place in the molecules of gross matter generally[3]

As the phenomena of rarefied gases are attracting attention at present, perhaps some calculations I have made (based on the mathematical results of others) in regard to conditions attending extreme rarefaction, may not be without interest. The fact that the mean length of path of the molecules (of a gas) increases in the *triple* ratio of the mean distance on rarefying, leads to some remarkable results, which would scarcely be expected perhaps unless they had been worked out—and have their application in regard to the long mean path required for gravity. For it is a consequence of this that while the mean distance of the molecules of a gas increases with extreme slowness on rarefying, the mean path augments at a great rate

[1] These postulates of Le Sage's theory relating to *supply* of matter from boundless space, &c, were unfavourably criticised by the late Prof Clerk Maxwell (*Encyc Brit*, 1875, under article "Atom") Prof Maxwell remarks (p 47) as follows —"We may observe that according to this theory the habitable universe which we are accustomed to regard as the scene of a magnificent illustration of the conservation of energy as the fundamental principle of all nature, is in reality maintained in working order only by an enormous expenditure of external power, which would be nothing less than ruinous if the supply were drawn from anywhere else than from the infinitude of space."

It will be seen that this objection vanishes by regarding the gravific æther as simply a stationary gas, within the limits of mean path of whose particles the gravitating parts of the universe are immersed, as then no *supply* of matter or expenditure of external power is required Also, it may be added, that a difficulty (mentioned p 47 of same article "Atom") in regard to the supposed excessive heating of gross matter that would occur under the impacts of the gravific particles, was considered by the present writer (*Phil Mag*, November, 1877), and a means suggested for removing it without the necessity for admitting any conditions which could be regarded as in themselves improbable.

[2] It is said that Faraday was the first to use the expression "radiant matter"

[3] To my mind, I must confess, it seems difficult to understand why "potential" energy (in the sense of an energy which is *not* kinetic) appears to be (comparatively speaking) so much brought to the fore-ground, to the exclusion of the intelligible view of *motion transferred from matter in space* Is it not in general considered a right principle to give preference to the intelligible or conceivable, in place of that which cannot appeal to our reason? Evidently the term "*kinetic*" (applied to energy) would be a redundant and superfluous prefix, unless it were thereby implied that some *other* energy than "kinetic" energy, viz., an energy *without motion*, existed

This may be perhaps best elucidated by a mode of illustration, which I have chosen with the endeavour, if possible, to convey clear conceptions to the mind, which is far more important than the mere writing down of numbers (millions, &c.) which afford no defined idea at all Some conception of what actually occurs when a gas is rarefied to a millionth of its normal density (a common amount in experiments) may perhaps be presented to the mind by supposing a cubical box, say one foot in the side, containing gas at normal density—hydrogen for instance—to be opened in a room one hundred feet in the side, containing a vacuum. This will then accurately represent the actual degree of rarefaction in the case under notice The mean distance of the molecules will then be increased (from known principles) in the ratio of the linear side of the cubical box to that of the cubical room, *i e* as 1 to 100. Since the mean distance of the molecules at normal density is known to have been about one seven-millionth of an inch[1] (according to the mathematical results obtained by the late Prof. Clerk Maxwell and others), the mean distance or rarefying to a millionth will become one seventy-thousandth of an inch (a hundred times greater, but still a very small distance) The mean length of path will have increased as the *cubic* contents of the room (*i e* in the triple ratio of the mean distance). The mean length of path (which is known to have been about $\frac{1}{250000}$ of an inch at normal density) will now have rapidly risen to the very perceptible dimensions of four inches (nearly) Here we have the state of "radiant" matter (previously existing however in the normal state of the gas, but concealed) coming to be quite appreciable to the senses For the gaseous molecules now "radiate" regularly to a mean distance of some inches from every point in the room, and if a portion of the gas were inclosed in a bulb, about four inches in diameter, the molecules would (on the average) strike across from one side to the other without colliding among themselves the beautiful "radiant" character of the motion then becoming lost, and the motion (and consequent pressure) irregular, owing to the confined space and absence of those mutual encounters among the molecules by which the motion is forcibly corrected and made symmetrical[2] It appears therefore that the truly "radiant" character of the motion (if we use the word in relation to the rays of light radiating from a luminous point) would then cease—though no doubt the term "radiant" may be also conveniently employed in another sense, viz. to express the fact [when a portion of gaseous matter is in a confined space where a proper adjustment of pressure is not possible] that the molecules may, by suitable means, be diverted from their paths, like the rays of light, so as to move in a parallel (or common) direction, and cast virtual shadows of objects placed in the bulb

It will be apparent therefore that the establishment of

[1] I quote this dimension from a former paper, "On the Nature of what is commonly called a 'Vacuum'" (*Phil Mag* August, 1877), a few of the data of which it is convenient to use here as a commencement It should be remarked that Mr Johnstone Stoney appears to have been the first to carry out calculations regarding molecular dimensions and distances, and to deduce therefrom conclusions regarding the number of molecules in unit of volume of a so-called "vacuum"—which tended to upset preconceived ideas

[2] It is evident that the "radiant" form of motion (or motion of the molecules *equally in all directions*) is the sole condition for equilibrium of pressure in all directions in a gas, or for an exact balance of momenta in every direction It is an obvious corollary from this—expressing a known fact—that if any imaginary straight line be taken anywhere in a gas, as many molecules at any instant are moving towards one extremity of the line as are moving towards the opposite extremity—the resolved components of the motions along the line being taken when the motions are oblique. It appears therefore that in order to bring gas rarefied to one millionth under the normal conditions for correcting the motions of its molecules (so as to move in the normal "radiant" manner), it would be necessary to employ a containing vessel of such size that the molecules can adjust their motions freely by mutual encounters. Hence a containing vessel whose diameter was a considerable multiple of the mean path (four inches in this case) would be required—say some feet in diameter at least.

the peculiar state of matter observed by Mr. Crookes does not depend on the rarefaction of the gas, but on the dimensions of the bulb (or confining envelope) relatively to the mean path—inasmuch as if it were possible to construct a bulb approximating to the mean path of the molecules of gas at (or near) normal density, analogous phenomena would inevitably occur, though of course they could not be observed by very small dimensions [Besides the electric discharge cannot so readily take place in dense gas.] What is done therefore is to raise the mean path approximately up to the diameter of the bulb (by a high degree of rarefaction), instead of—conversely—diminishing the bulb down to the length of mean path (at a lower degree of rarefaction), when the effect would be difficult to perceive from the smallness of scale It will be observed that it is only a question of scale (rarefaction being a mere relative thing)—only it becomes possible to use a bulb or containing vessel of larger size (to produce the conditions) in direct proportion as the rarefaction is greater, so that the whole effect becomes more magnified and distinct The truth of this view may be more apparent by considering the case of the atmosphere when, at different heights, different degrees of rarefaction prevail Let us take the heights where the mean path of the molecules is (say) one tenth of an inch, one inch, and ten inches respectively Then at all these heights (as at ordinary density) the molecules of the gas move in the same normal "radiant" manner, or there is nothing peculiar about the state of the gas at any degree of rarefaction If now a portion of gas be inclosed at each of these heights in bulbs of one-tenth of an inch, one inch, and ten inches in diameter respectively then the gas in all these bulbs will be in an abnormal condition, or in that peculiar state where it has ceased to have the power of adjusting its pressure, and consequently the phenomena of diverting the molecules (by suitable means, electric, &c.) into any paths at desire will be possible in all the bulbs. These considerations will perhaps contribute something towards clearing up any difficulties or divergence of views as to the theoretic aspects of this question which happens to trench on a line of inquiry pursued by the present writer for some years. Returning to our former example, it may be instructive to consider what takes place on further rarefying Suppose the rarefaction to be carried to another millionth, by opening out our cubical room into another whose linear side is 100 times greater, viz, 10,000 feet Here the mean distance of the molecules becomes one seven-hundredth of an inch (multiplying by a hundred)—still a very small quantity, it will be observed. It may be remarked that by this degree of rarefaction (about a million times further than a good mercurial pump could attain) there are still no less than 340 million molecules in each cubic inch of the space. The mean path however has now sprung to sixty miles—greater than the dimensions of the room (by about twenty to thirty times)[1] Our room has therefore approached the state of a confined bulb where the molecules of gas have lost control over themselves, or cannot adjust their motions so as to move in a "radiant" manner, but the molecules rebound irregularly backwards and forwards from one wall to the other, without (as a rule) colliding together, and may produce considerable irregularities of pressure In order to restore the uniformity of pressure, and reproduce the normal "radiant" form of motion, it would be necessary to open out our room into another a considerable multiple of sixty miles in the side (the mean path)—adding fresh gas so as to leave the density unchanged Here we should have molecules moving in streams and passing within (on an average) one seven-hundredth of an inch of each other, and "radiating" from each point of the room with perfect symmetry to a distance of many miles, like the rays of light from a luminous point In this case we should have molecules capable of becoming virtual carriers of energy to radial distances such as might really in principle serve to some extent the practical object required in the case of light

If we imagine (for further illustration) the rarefaction carried a million times beyond this—viz, to a millionth × a millionth × a millionth of an atmosphere—then the mean distance of the molecules would still only have risen to the small amount of one-seventh of an inch, but the mean length of path sixty million miles (about) We are thus approaching astronomical distances. It seems a curious fact to consider that a portion of matter can be projected among other portions only one-seventh of an inch apart, so as to move (on the average) sixty million miles without touching one of them This may form an illustration of the smallness of molecules A hydrogen molecule moving at about four times the velocity of a cannon ball (its normal rate) would take, calculably, about a year and three quarters to traverse its mean path under these conditions

These considerations may serve to show, or facilitate the conceptions as to how particles of matter may have an extremely small mean distance and yet have an extremely long mean path For it is readily conceivable that since (as has been mathematically proved by Clausius and others) the mean length of path of a particle increases, *cœteris paribus*, as the *square* of its diameter diminishes (a rapid rate)—particles, such as those of the æther, for instance, may have such an adequately small diameter as to admit of being in very close proximity, and yet their mean path extremely great (many millions of miles long perhaps) These conclusions, rendered more interesting by the additional light thrown on streams of molecules in the gaseous state by the experimental researches of Mr Crookes—would therefore point, in their possible application to the æther, to a possible means for carrying energy in a "radiant" manner, producing gravity (or the general phenomena of *approach*), and capable of serving as a great source of motion, the transferences of which are illustrated and exemplified in the motions developed in gross matter on every hand, and which to the appreciative mind who will not admit the *creation* of motion, inevitably demand the presence of an agent inclosing a hidden store of motion The above view would also have the advantage of correlating the æther with ordinary matter (as merely a body consisting of very much finer molecules—or a difference of scale). Why should we suppose the æther to be something abnormal or different from ordinary matter, without positive evidence? Would not this be a deviation from the rule of admitting *one* principle as sufficient until two are found to be necessary? This also holds in regard to energy Why countenance at all *two* kinds of energy until we have evidence, or why deviate from *one* grand fundamental principle until we are forced to do so—hardly a probable event, especially when this deviation involves something like a rush into the inconceivable represented by an energy *without motion*?[1]

In conclusion it should be observed that there is nothing hypothetical in the above deductive results re-

[1] It evidently follows from these considerations that if it were possible by some practical means to expand a glass bulb after rarefying, the mean path of the molecules of the inclosed gas would increase three times as fast as the diameter of the bulb

[1] The apparently logical plan of admitting *one* principle until *two* are shown to be necessary would appear to be reversed in the case of energy It would seem that *two* kinds of energy are first believed in, because the existence of one kind is not (as it is said) *physically* proved yet—*i e* proved in such a way as to be obvious to our gross senses, and not merely a deduction derived from pure reasoning based on the observed and otherwise inexplicable developments of motion taking place in gross matter everywhere around us. Some might think that the contrary procedure to the above would be the more logical—viz, to believe in one kind of energy, *because the existence of two kinds had not been proved yet* But in the history of science there has notoriously always been a tendency to lean towards the inconceivable, rather than be contented with what our understanding can teach us. At a future day possibly the recognition that all energy is of *one* character will be thought by some a grand discovery Some may however think it to be only the correction of an error which ought never to have been committed, for which there was no real justification—all analogy, rationality of conception, and that *oneness* of principle so characteristic of nature pointing the other way

garding the mean distances, mean paths, &c., of molecules on rarefying gases. For the relations computed depend on known mathematical principles. The only possible ground for question would be the particular data of mean distance, &c., taken as a basis for the calculations. But it should be noticed that these rest on an experimental basis: having been deduced from observed facts by investigators of admitted competence, and by means of several *diverse* lines of argument which are found to accord in a remarkable manner as to the results,—which is therefore strong confirming evidence of their substantial accuracy. Also the above inferences regarding a mechanism for the fundamental purposes of carrying energy, storing energy in equilibrium, and producing effects of approach (such as gravity, &c.), cannot as mechanical facts admit of any question. For mechanical principles (like mathematical truths) hold independently of any inquiry as to whether they actually find practical *application* in nature or not. The best argument for their practical application in nature is the incomprehensibility of observed facts without them. We can at least say with certainty that under such conditions, effects (phenomena of approach,[1] transferences of motion, &c.) of the character observed would be produced,—and which effects have not hitherto found any explanation that appeals to our reason. The certainty of simple and automatic mechanical conditions being conceivable which are capable of producing such important effects, should lend a legitimate interest to these inquiries, and the mechanical beauty of the "radiant" adjustment of moving particles of matter which adapts them to so many noteworthy purposes at once, should surely itself be an argument in favour of the practical application of the scheme in nature,—as a simple means to great and important ends.

S. TOLVER PRESTON

DEEP-SEA OPHIURANS

IN the anniversary *Memoirs* of the Boston Society of Natural History, Prof. Theodore Lyman gives an account of a structural feature hitherto unknown among Echinodermata which he has discovered in deep-sea Ophiurans. The remarkable structures described appear under the microscope as little tufts resembling bunches of simple Hydroids on the sides of the arms of certain Ophiurans. On careful examination these tufts are found to be bunches of minute spines, each inclosed in a thick skin-bag, and in form resembling agarics, or parasols with small shades. They are arranged in two or even three parallel vertical rows, and in this respect the animals on which they occur differ from all other Ophiuridæ known, for all others possess a single row only of articulated spines. The peculiar tufts, which are apparently homologous with pedicellariæ, are attached to the outer joints of the arms, near the margins of the side arm-plates. Two new genera, Ophiotholia and Ophiohelus, closely allied to Ophiomyces, are described in which these curious appendages occur. The species of the genera are soft with imperfect calcification. Examples of Ophiotholia were dredged off Juan Fernandez, in 1825 fathoms, and of Ophiohelus off Barbadoes in 82 fathoms, and off Fiji in 1350 fathoms.

Prof. Lyman states that among the Ophiuridæ and Astrophytidæ of the *Challenger* Expedition the entire number of new genera brought home is 20; that of species 167.

[1] It would not be difficult substantially to imitate what occurs in gravitation (according to the dynamical theory), by cooling down the opposed faces of two metal disks freely suspended in a moderately large vessel of rarefied gas, at a less distance apart than the mean length of path of the gaseous particles,—when from known principles (already experimented on by Mr. Crookes) the two disks would approach. Here the diminished velocity of rebound of the gaseous particles from the cooled inner surfaces of the disks (which entails the approach), is imitated in gravitation by a similar diminished velocity of rebound of the gravific particles from gross matter, owing to their translatory motion being partly shivered into vibration (and rotation) at the shock of impact against gross matter (in a manner elucidated by Sir W. Thomson, *Phil. Mag.*, May, 1873). On a large scale a similar diminution of translatory motion at impact is universally illustrated by the known retarded rebound of elastic masses at collision,—when part of the translatory motion is (in a somewhat analogous way) converted into a vibratory or rotatory motion of the colliding body at the encounter. It becomes interesting in a dynamical phenomenon of the nature of gravitation to contemplate the possibility of doing something towards illustrating it experimentally, and to acquire the certainty of the existence of the streams of particles which produce the effect,—by almost visualising them, through the means employed in the recent researches by Mr. Crookes.

AN ELECTRICAL THERMOMETER FOR DETERMINING TEMPERATURES AT A DISTANCE

THE success of many industrial operations depends upon the steady maintenance or proper variation of certain temperatures, and it is often of the highest importance that the person in charge of these operations should be able readily to ascertain by means of the thermometer if the workmen are performing their duties correctly. It sometimes happens that thermometers have to be placed in positions which are difficult of access, or removed some distance from the centre of the manufactory, and that considerable time has to be expended in visiting the different stations. It was in order to meet the requirements of such a case as this that the electro-thermometric apparatus here described was constructed.

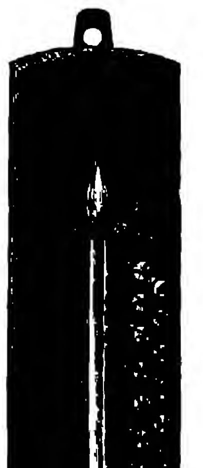


FIG. 1.

I had for some time been much in need of an instrument which would admit of the temperature of a series of malt-drying kilns being determined at a considerable distance from the kilns themselves, and, not being able to meet with a description of a suitable instrument, I was led, after several trials, to contrive this apparatus, which, although it does not embody any new principle, and is not perhaps adapted to accurate meteorological work, is nevertheless very suitable for the technical purpose for which it was originally designed, and is doubtless capable of extended application in many industries.

The apparatus consists essentially of two parts, a mercurial electro-thermometer, and a combination of apparatus which constitutes an automatic receiver and transmitter of signals from the thermometer.

The thermometer, which is shown in Fig. 1, was constructed for me by Mr. J. Hicks of Hatton Garden. It is an ordinary thermometer about nine inches in height, with a large bulb and a stem of wide bore. Through the side of the stem, and fused into the glass, are inserted a series of short platinum wires, the free end of each being connected with a binding screw. These wires, which project slightly into the bore of the thermometer, are, in my instrument, inserted at intervals of 3° F. between 120° and 171°, the range of temperature required in this case. The constructor of this part of the apparatus informs me that, if necessary, there is no practical difficulty in inserting wires at intervals of a single degree, or even less, without interfering with the calibration of the tube. The upper part of the bore of the tube is expanded

into a small bulb which is partly filled with glycerine, this

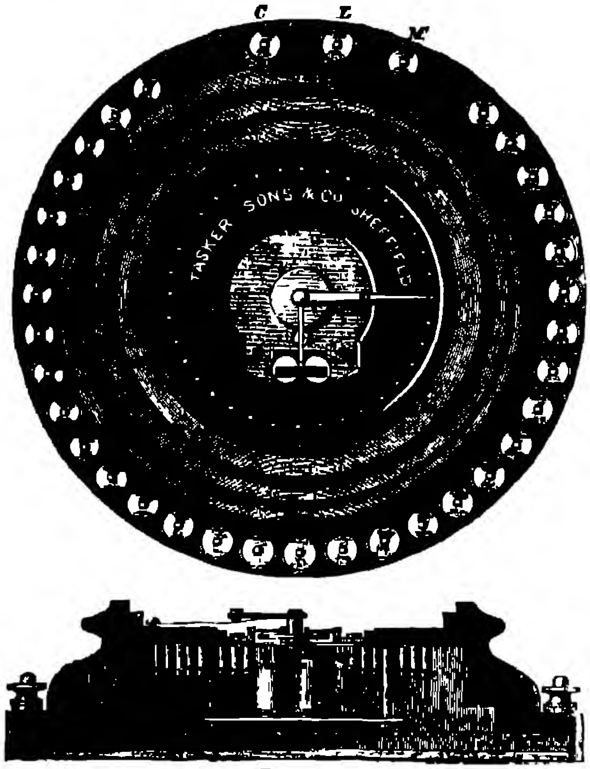


FIG. 2

liquid of course also filling the bore of the tube above the mercury column. A wire fused into the main bulb of the thermometer is connected with a binding-screw from which a wire leads to one pole of a battery of two Leclanché cells, the opposite pole of the battery being placed permanently to earth.

If the free end of a wire, put to earth through a galvanometer or bell, is brought successively in contact with the binding-screws at the side of the thermometer, commencing at the lowest, a signal will be given from each wire in contact with the mercurial column, but not from the wires above it. By carrying a conducting wire from each of the binding-screws to a series of ordinary electrical bell-pushes arranged on a key-board, the main bar of which is put to earth through a signalling apparatus, it is evidently possible to ascertain at any distance from the thermometer the height of the mercury column, and consequently the temperature, the mean error of observation depending upon the intervals between the wires inserted in the bore of the thermometer. Such a form of apparatus is however inconvenient, as it necessitates carrying a large number of insulated wires to the observing station.

To avoid this difficulty I have devised the *transmitting* portion of the instrument, an apparatus which, placed as near as is convenient to the source of heat, is capable of collecting the various signals from as many different thermometers as may be desired, and of transmitting all these signals down a *single* wire to an observing station at any required distance. This part of the apparatus, shown in Fig. 2, was constructed for me by Messrs. Tasker and Sons of Sheffield. It consists essentially of an ebonite ring, through the thickness of which are inserted, at even distances, a series of small platinum studs, terminating level with the surface of the ebonite ring, and connected at the lower side with a series of binding-screws arranged round the circumference of the circular wooden frame enclosing the instrument. Within the case of the instrument is an ordinary clockwork

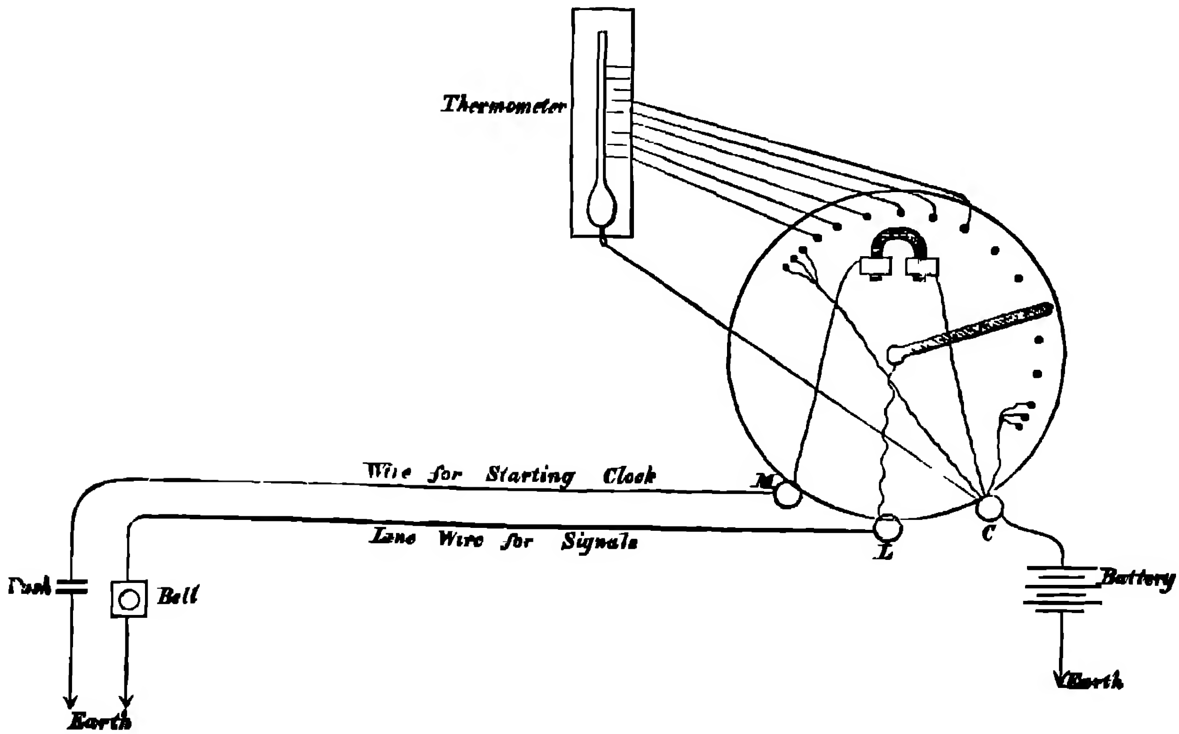


FIG. 3.

motion driving a small metallic traverser, which is capable of a somewhat rapid movement similar to that of the hand of a watch. This traverser, furnished at its extremity with a small piece of platinum, is caused, by

means of an adjusting screw, to press lightly against the face of the ebonite ring, and to produce metallic contact with the studs when passing over them The binding screws around the case of the instrument are connected in serial order with the wires inserted in the bore of the thermometer, and the traverser is in permanent electrical contact with the binding screw L, to which is attached the line-wire

If the transmitter is intended to convey the signals from more than one thermometer, there are inserted in the ebonite ring, at suitable intervals, three small platinum studs very close together. These studs are not in connection with the thermometers, but with the binding-screw C, which is in permanent connection, through the battery, with earth By this arrangement the current is short-circuited whenever the traverser passes over these extra studs, and the three signals sent down the wire in quick succession serve to show that the transmitter has commenced to send signals from another thermometer

The axis which drives the traverser carries round with it a metallic disk, which is drilled with a hole into which fits, when the clockwork is at rest, a small plug This plug, which acts as a detent, is attached to the heavier side of a light lever, the opposite end of which is furnished with an iron armature in close proximity to the poles of a very small electro-magnet One end of the magnet coil is connected with the binding-screw C, and so through the battery with earth, whilst the other end of the coil is connected through the binding-screw M (Figs 2 and 3) with another line-wire which is carried to the observing station, and is capable of being put to earth through an ordinary electric bell-push

The general arrangement of the whole apparatus is shown in the diagram, Fig 3 The action of the instrument is as follows —The line-wire connected with M is momentarily put to earth at the observing station by depressing the bell-push, this causes a current to circulate round the coils of the electro-magnet, which, attracting its armature, liberates the detent, and starts the clock The number of signals now passed down the line-wire by the passage of the traverser over the platinum studs will be a measure of the height of the mercury column in each thermometer. The traverser, having made one complete revolution, is arrested by the falling of the plug into the disk

It is evident that any number of observing stations can be established along the line-wire, and also that, if desired, the apparatus may be made automatically to register the temperature at any required interval of time.

HORACE T. BROWN

THE RECENT DISCOVERY OF THE BODY OF RHINOCEROS MERCKII IN SIBERIA

IT is a well-known fact that carcases of extinct animals, such as the Mammoth (*Elephas primigenius*) and Tichorhine Rhinoceros (*Rhinoceros tichorhinus*) are obtained in a more or less perfect state of preservation in the frozen tundras of Siberia A memoir recently presented by Dr Leopold von Schrenck to the Imperial Academy of Sciences of St Petersburg,[1] informs us that the most recent discovery of this nature (which took place in 1877) is of a specially interesting character The remains found upon this occasion turn out, not to belong to either of the above-named animals, but to a distinct species of Rhinoceros, *Rhinoceros Merckii* (better known in England as *Rhinoceros leptorhinus* of Owen), which had never been known previously to occur in such a condition. Unfortunately full advantage has not been taken of this extraordinary discovery. Although the carcase, as already mentioned, was found in 1877, it was not until March, 1879, that it came to the knowledge of the Imperial Academy. At the same time the sad fact was communicated that only the head and one foot of the whole body of this extinct monster had been preserved, all the remaining portions having been allowed to drift away into the River Yana, upon the banks of which it had first come to light

[1] "Das erste Fund einer Leiche, *Rhinoceros Merckii*, Jaag" Von Dr Leop v Schrenck (Mém Ac. Imp Sc St Pet, viie série, vol xxvii No 7, 1880)

The head in question, after having been exhibited in Moscow, at the Anthropological Exhibition of 1879, was presented to the Zoological Museum of St Petersburg, where upon comparison with the Tichorhine Rhinoceros, it was shown to belong, not as had been previously supposed, to that species, but to *Rhinoceros Merckii*.

Of this specimen, which is naturally reckoned among the greatest treasures of the Imperial collection, Dr L. von Schrenck now gives us an excellent description, illustrated by several figures, which show that in external as well as (as now already known) in osteological characters, *R. Merckii* presents many salient features to distinguish it from *R tichorhinus*.

As regards the former distribution of *R. Merckii*, although it was once supposed that this species was confined to Western and Southern Europe, recent researches had already proved that this extinct rhinoceros had a much more extensive range Besides being found in several localities in Eastern Europe, Brandt, in his excellent Memoir on the Tichorhine Rhinoceroses, has shown that this species formerly existed in Eastern Siberia. It is therefore not now so remarkable that a whole frozen body of this former inhabitant of the Steppes of Siberia should have been discovered on the banks of one of the rivers, preserved frozen during many thousands of years, as we know to have been also the case in the previously obtained specimens of the Mammoth and the Tichorhine Rhinoceros

NOTES

WE give on another page an abstract of the revised edition of the proposed statutes on the professoriate promulgated by the Oxford University Commissioners It is, to say the least, hopeful to find the Commissioners so amenable to criticism and suggestions, and the proposed revised statutes, it will be found, obviate most of the objections which came from all quarters to the harassing and humiliating nature of the first draft. Occupying the position we do in relation to science, we could not but condemn the statutes in their first form Were we the mouthpiece of the College of Preceptors, then possibly we might not have objected to the Oxford professors being legislated for as if they were merely elementary school-teachers; but as we are bound to consider the interests of science and its advancement, and as we believe one of the chief duties of an Oxford professor, as of a German or a French professor, to be original research, we could not but consider the statutes in their first form as a serious blunder.

ON Monday, March 15, the Paris Academy of Sciences held its annual sitting, when the prizes for 1880 were delivered. M. Ed. Becquerel was in the chair He opened the sitting by an *éloge* of M. Michel Chasles, who died quite recently, and who was one of the most popular members of the Academy. At the end of his address he reminded his fellow members of the completion of the great work of M. Milne-Edwards, which has lasted for a quarter of a century. The great prize for mathematics was awarded to M. Halphen, with honourable mention to M Poincarré, the Poncelet Prize to M. Leonte, engineer of the machinery constructed by the Government. A sum of 3000 francs was awarded to M. Ader for having advanced in an essential manner phonetic telegraphy (also telephony) The Trémont Prize was awarded to M. Vinot, the editor of the only astronomical paper published in France, and the founder of the only astronomical society M. Dumas, with

his usual eloquence, read the *éloge* of M. Victor Regnault, the celebrated physicist. M. Regnault was born in Germany during the occupation of the Rhenish provinces by France. His father was killed during the invasion of Prussia by France, and his beloved son was killed during the siege of Paris. After the last event took place Regnault's life was a long agony, which M. Dumas described with touching eloquence.

THE Transit of Venus Commission established by the French Academy of Sciences has resumed its labours under the presidency of M. Dumas. A credit has been given by the Government for constructing new refractors. Not less than twelve are now building, to be used on the several stations which have been already selected, and will be ready by the end of the year The heads of the scientific missions will soon be appointed, as well as their staff The greater number of instruments built for the 1874 transit have been disposed of to several public institutions.

SIR JOHN LUBBOCK showed a good deal of courage in introducing his motion on Ancient Monuments into the House of Commons in the present temper and obstructed condition of that body; nevertheless he carried his point All he did was to move that in the opinion of the House the Government should take some steps to provide for the better protection of ancient national monuments, the House declared itself of this opinion by a considerable majority, though, we imagine, something more must be done before Government has the power to step in and prevent the destruction of any ancient monument That there is no time to be lost if we do not wish most of these relics of the past to disappear entirely, is evident from the long list given by Sir John Lubbock of important monuments that have already been mutilated or destroyed. Sir John suggested that any owner of such a monument who contemplated its destruction should be compelled first to offer it for sale to the country This course would be both simple and effective.

MR. ROBERTS of the Nautical Almanac Office is authorised by resolution of Council of the Secretary of State for India, dated August 7, 1880, to make it generally known that his Tide Predicter may be employed for the preparation of Tide Tables (subject to the payment of a nominal fee to the India Office for the use of the machine) for any port for which the requisite data are forthcoming on application to him. The Tide Predicter has already been used for the preparation of the Tide Tables for 1880 for the ports of Bombay and Kurrachee (published by authority of the Secretary of State for India in Council) with the most satisfactory results. It has also been used for the Tide Tables for 1881 for Indian ports, which include, in addition to those of Bombay and Kurrachee, the tides also for Aden, Okha Point, and Beyt Harbour (Gulf of Cutch), Karwar, Beypore, the Paumben Pass, and Vizagapatam. The Tide Tables for 1882, the preparation of which is already far advanced, will include, in addition to the above eight ports, the following seven, viz.:—Madras, Rangoon, Moulmein, Port Blair, and on the Hooghly River, Fort Gloster, Diamond Harbour, and Kidderpore (Calcutta). It is anticipated that in addition to a still further number of Indian ports to be predicted for 1883, that Mr Roberts will have the preparation of Tide Tables for Table Bay, Port Elizabeth, East London, and Durban, tidal observations at these places being now in progress, or shortly to be commenced for this purpose. The observations, when a sufficient series has been taken, will be placed in the hands of Mr. Roberts for the determination of the requisite data for the predictions.

THE Senatus Academicus of Aberdeen University have resolved to confer the degree of LL.D. on David Ferrier, M.A., M.D., Professor of Forensic Medicine in King's College, London

WE have received from Mr. Marsden of Regent Street, Gloucester, a "List of British Birds," with, as an appendix, "The Graduated List for Labelling Eggs" With similar lists the present one compares favourably, and it is a pity that Mr. Marsden, who is evidently an intelligent man, did not make his catalogue still more perfect. The insertion of species like the Russet Wheatear (*Saxicola stapazina*), and the Barred Warbler (*Sylvia nisoria*), which are not entered in so recent a work as Newton's edition of "Yarrell," show that the author is abreast of the latest information on the subject of rare visitants to this country. But the Black-winged Kite (*Elanus cæruleus*) has equal rights to a place in a British list, and we are sorry to see the Great Black Woodpecker (*Picus martius*) and the Rufous Swallow (*Hirundo cahirica*) still allowed as visitors to Great Britain The careful researches of Mr. J H. Gurney, jun., published in Sharpe and Dresser's "Birds of Europe," have entirely disproved ever single supposed occurrence of the Great Black Woodpecker, while the so-called Rufous Swallow turned out to be nothing but a common *Hirundo rustica* in fine spring plumage. The abbreviations of authors' names are, to say the least, ingenious, but as they differ in nearly every case from those adopted by all ornithologists, we cannot perceive any real advantages to be gained by their use, as they involve continual reference to the introductory explanation to find out the author's meaning. If brevity in quoting authors' names is desired, "Bp." for Bonaparte is better than "Bo," and is moreover frequently so employed. "Bon" in Mr. Marsden's list means Bonnaterre, but in many ornithological works Bonaparte is thus signified, so that we cannot commend this portion of the author's labours We were at first puzzled as to the meaning of the "Graduated List for Labeling," but we find on referring to it that the names of the British birds are there printed in various-sized types according to the size of the different bird's egg, and we are sorry to think that there is still a demand for a list of this kind whereby collectors become satisfied with the printed name attached to their captures instead of having, as every genuine egg should have, the full particulars of its history written upon it in ink.

THAT we may still expect many additions to the avi-fauna of Eastern Africa has been amply proved during the past year or two by the collections sent from the East Coast by Dr. Fischer to Berlin and Dr Kirk to this country A further contribution has recently been made by the veteran ornithologist, Dr. Hartlaub, who has just published in the *Abhandlungen* of the Bremen Natural History Union an interesting paper on Birds, collected by Dr Emin Bey in the region of the Upper Nile. The traveller proceeded from Lado in 5° N lat. along the Nile to the Albert Nyanza, visiting the northern extremity of the Coja Lake, and traversing the country in a northerly direction to Fatico The result of this expedition considerably modifies the generally received opinion respecting the relation of the avi-fauna of the Upper Nile region, for although a large number of the species obtained are, as might be expected, Abyssinian, there is a certain infusion of South and West African forms, with a sprinkling of peculiar genera and species. The new species described are as follows:—*Cisticola hypoxantha, C. marginalis, Eminia* (g.n.) *lepida, Drymocichla* (g.n.) *incana, Dryoscopus cinerascens, Tricholais flavotorquata, Muscicapa infulata, Hyphantornis crocata, Hyphantica cardinalis*, and *Sorrella emini*. The Whale-headed Stork (*Balæniceps rex*) was looked for in vain on the Victoria and the Albert Nyanzas, and is said to exist only north of Schambé.

MESSRS. W. EAGLE CLARKE and William Denison Roebuck, secretaries of the Yorkshire Naturalists' Union, are preparing for publication "A Handbook of Yorkshire Vertebrata: being a Complete Catalogue of British Mammals, Birds, Reptiles, Amphibians, and Fishes, showing what Species are or have, within

Historical Periods, been found in the County of York." The authors state that when engaged on the compilation of various papers on the natural history of the county for the *Transactions* of the Yorkshire Naturalists' Union, find that there is a deficiency of information of a reliable nature as to the detailed distribution in Yorkshire of the various species of vertebrated animals, and this in spite of the fact that all available published information has been by them systematically and diligently collected. This deficiency they believe to some extent arises from the circumstance that never yet has there been published a list of the vertebrated animals (or of any subdivision thereof) of the county as a whole. Such a list they propose to supply. The Birds will be undertaken by Mr Clarke, the Mammals, Reptiles, and Amphibians by Mr Roebuck, and the Fishes jointly. The writers would be glad to have co-operation, in the way of supplying lists and notes for as many districts in the county as possible. Scattered observations on any species are as much desired as lists Notes on the historical evidence of the former existence of species in the county, and on the local names used for the various species, are also desirable. Communications are requested to be addressed to either author at his residence, or at No. 9, Commercial Buildings, Park Row, Leeds

THE *Times* correspondent sends some additional facts to account for the recent earthquake at Casamicciola "The lamentable accident," Prof. Palmieri states, "which has happened at Casamicciola was not only not felt by the University seismograph, nor by that of Vesuvius, but did not extend even to the whole of the island It must be regarded, therefore, as a perfectly local phenomenon, produced probably by the sinking of the soil occasioned by the slow and continual subterraneous action of the mineral waters" That there were severe shocks of earthquake, the *Times* correspondent goes on to say, is unquestionable, but unless the ground had, so to speak, been prepared for it, the disaster would probably have not been so great. The fact is that the island is burrowed in many parts. Wherever there is any chance of finding a spring the ground is hollowed out, and the fortunate proprietor makes a good thing of it during the season In addition to this fact, a considerable part of the soil is formed of clay, which is held in high estimation, and not merely Naples, but the country around to a great extent, is provided with bricks and pottery from Ischia This branch of industry has been carried on successfully for many years, and it may readily be understood, therefore, that the subsoil is so perforated that any violent shock suffices to wreck the houses on the surface. Ischia is well known to be of volcanic formation, and has, in times long past, been subject to shocks and eruptions from Epomeo, the now dormant cone in the centre of the island What is called the Lake of Ischia is supposed to have been the crater of an extinct volcano. The last great eruption occurred in 1301, and lasted two months, inflicting complete ruin on the island A scientific Commission, composed of Professors Palmieri, Scacchi, Linno, and Guiscardi, have gone to Casamicciola to endeavour to ascertain whether the earthquake there was due to local causes or not.

EARTHQUAKE shocks continue in Switzerland to an extent that, in view of the terrible disaster at Ischia, is causing considerable apprehension A very strong oscillation was observed at Heniveil, in Zürich, early on Monday morning, and about two o'clock on the following morning two separate shocks were felt at Lausanne. Two deaths resulted in a rather singular way on Friday last from the earthquake of the preceding day. The shock loosened a mass of rock overhanging a quarry at Oberburg, in Berne, and twenty-four hours afterwards it fell, literally grinding to powder two unfortunate men who were working hard by.

IT has been decided by a large number of friends and admirers of the late Mr. Frank Buckland to perpetuate, by a substantial memorial, the services which he has rendered to the study of natural history and fish-culture by his numerous writings, and also by the formation of his celebrated fish museum at South Kensington, which he has bequeathed to the nation. A committee which has been formed with this object in view includes amongst others Sir William Vernon Harcourt, M P., Sir Philip Cunliffe-Owen, Prof. Owen, Mr. Spencer Walpole (Inspector of Salmon Fisheries), and several other gentlemen representing the different fishery boards throughout the country and the various fishery interests The exact form which the memorial shall take has not yet been determined This will be decided at the next meeting of the committee, which will shortly be held.

WE hear that Mr Walter Hill is about to retire from the Curatorship of the Botanic Gardens at Brisbane, in connection with which his name has become widely known. It is rumoured that the Gardens will be placed under the management of a board.

WE are glad to see that the Liverpool College of Chemistry has been reopened after being renovated and refitted with modern apparatus for research. Under the guidance of Dr Tate and Mr G H. Sharpe, we have no doubt it will prove a useful centre for instruction and science

THE stenographic machine which we mentioned in our last issue was presented on March 11 to the Société d'Encouragement, meeting under the presidency of M Dumas It is a small instrument, about 1½ foot long and 1 foot wide, placed on a stand 2½ feet high, on which it is easy to play with both hands. The number of elementary signs is only six, which by mutual combination give seventy-four phonetic letters It has been worked with an astounding velocity, reproducing the words pronounced by a man reading a passage from a book. The limit of velocity is stated to be 200 words in a minute, which is more than sufficient, no speaker having ever uttered more than 180 The signs are very neatly printed on a paper band passing automatically under the types They can be read by any person conversant with the peculiarities of the system, which requires the teaching of a very few months. The work of the stenographer is more difficult, but in little more than a year he can be educated Women and persons who have an acute and correct hearing can practise it with success. Blind people, generally having very delicate hearing, will be most useful, the reading and translation being done by other people The same machinery is available for every language in existence The system is so perfect that it can be used for reproducing a language that is neither spoken nor understood by the operator But under such circumstances the orator must speak slowly and in a very distinct manner This machine was worked by a young lady belonging to the stenographic staff of the Italian Senate, where the machine is in constant use

THE work of laying subterranean cables is proceeding favourably from Nancy to Paris This telegraph line is composed of twelve insulated wires placed in a large tube of cast iron For each length of 500 metres doors have been arranged so that any section can be removed and replaced without having to open the ground, which is necessary in the German system of laying the cables in a solid bed of asphalte.

WE are asked to make known that at the request of the Commissaire-Général, the Society of Telegraph Engineers and of Electricians have undertaken to supply to and collect from intending British exhibitors, applications for space at the forthcoming Exhibition. Forms of application and copies of the general rules can be obtained at the offices of the Society, 4, Broad Sanctuary, Westminster, London, by letter addressed to

he Secretary of the Society, or by personal application between the hours of 11 and 5.

THE *Photographic News* of March 11 publishes an excellent photo-engraving of Fox Talbot.

MR. W. HEIGHWAY has issued a useful "Handbook of Photographic Terms," an alphabetical arrangement of the processes, formulæ, applications, &c., of photography for ready reference. Piper and Carter are the publishers.

A NEW Natural History Society has been formed at Banbury under the title of "The Banburyshire Natural History Society and Field Club" Mr. T. Beesley, F C S., is president, and Mr. E. A. Walford, hon secretary

THE *Times* Dublin correspondent telegraphed on Sunday night —"A very interesting scientific work, the most important of its kind yet attempted in the kingdom, has just been completed. It is the great refracting telescope, constructed by Mr Grubb of Rathmines, Dublin, for the Austro-Hungarian Government, and it is to be placed in the Observatory at Vienna. A commission appointed by the Government to examine the work transmitted yesterday to the Austro-Hungarian Embassy in London a report expressing their full approval of the manner in which the task has been completed It is a matter of no little pride to Ireland that she has produced the largest refracting as well as the largest reflecting telescope in the world" Several interesting details concerning the telescope are give in the *Irish Times* of March 10

M. LOUIS FIGUIER's *L'Année Scientifique et Industriel*, published by Hachette and Co., is a really useful summary of the science of the year The twenty-fourth issue is quite up to previous volumes, and in the absence of anything of the kind published in this country may prove serviceable to English readers.

THE *Annuaire* of the Montsouris Observatory for 1881 contains much useful information in meteorology and allied subjects. Under the head of Agricultural Meteorology are a variety of experimental data on the action of heat, light, and water on vegetation, with their application to special cultures There is also a meteorological *résumé* for the agricultural years 1873-80, and an article on Bacteria in the Atmosphere.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus radiatus*) from India, presented by Mr. R. W. Okes-Voysey, an Azara's Fox (*Canis azaræ*) from Buenos Ayres, presented by Mr William Petty, a Gold Pheasant (*Thaumalea picta* ♂) from China, presented by Mr. W H St. Quintin, an Ornamental Ceratophys (*Ceratophys ornata*) from Buenos Ayres, presented by Mr E W White, F.Z S.; a Water Vole (*Arvicola amphibius*), British, purchased, two Dingo Dogs (*Canis dingo*), born in the Gardens

CHEMICAL NOTES

OBSERVATIONS have been published from time to time concerning the existence of alkaloid-like substances in exhumed corpses. These substances appear to be produced in organised matter which, after brief exposure, has been kept out of contact with air. A summary of these observations and a discussion on their bearing on toxicological examinations is given by Husemann in a recent number of *Archiv fur Pharmacie*. Substances having different physiological actions appear to be produced at various stages of decay of flesh or vegetable matter. A substance resembling atropine in its action has been separated from an anatomical maceration fluid by Sonnenschein, and this same substance has been found in the bodies of persons who have died from typhus fever.

AN important paper on "The Influence of Isomerism of Alcohols on the Formation of Ethereal Salts," by Menschutkin, appears in *Annales Chim et Phys*. The process of etherification reaches a limit in every instance, but this limit varies with the molecular weight, and generally with the "structure" of the alcohol employed In the ethylic series the limit increases with increase of molecular weight, but is not influenced by isomerism; in the secondary alcohols the limit does not show an increase for increased molecular weight. The influence of isomerism is most marked in this series

IT is well known that by adding dilute acid to a solution of sodium thiosulphate and warming, a copious precipitate of yellow sulphur is obtained Colson states in *Bull Soc. Chim* that when a very dilute solution of sodium thiosulphate is added to dilute hydrochloric acid, hydrogen sulphide and sulphuric acid are alone produced. He supposes that the water present acts on the sulphur as quickly as it is liberated from the thiosulphate, in the manner indicated, if flowers of sulphur be acted on by boiling water, a similar reaction occurs, but proceeds only very slowly

FROM a study of the thermal phenomena which accompany the action of water on alcohols, and of alcohols on water, Alexejeff (*Bull Soc Chim*) concludes that hydrates of the saturated alcohols exist, which hydrates are less stable the greater the number of carbon atoms in the molecule

THE heats of formation, and of solution, of a large series of metallic sulphides, and sulphydrates, principally those of the alkalis and alkaline earths, have been determined and published in *Annales Chim. et Phys.* (January), by M. Sabatier.

IN an investigation of alcoholic fermentation (*Annales Chim et Phys*) Boussingault states that by the addition of a large quantity of yeast to wines rich in sugar, fermentation proceeds rapidly at a boiling temperature, provided the pressure be considerably diminished

IN the *Berliner Berichte* Herr T Donath describes experiments on *chinolin*, in which he shows that this alkaloid possesses marked antiseptic properties in 0 2 per cent. solution it stops the putrefaction of urine and lactic fermentation; in 0 4 per cent. solution it completely stops the putrefaction of blood and largely decreases the coagulation of milk. Blood containing 1 per cent. of chinolin cannot be coagulated At low temperatures the alkaloid forms compounds with albumin, which coagulate

IN a paper "presented to both Houses of Parliament" the subject of "*oleomargarine*" as manufactured in the United States is discussed This substance is made from beef suet by disintegrating in warm water, passing through a fine sieve, melting at 120° F, settling, draining off the oil, and allowing to solidify. If "*butterine*" is to be made, the oil is mixed with 10 per cent of milk, churned, coloured with annatto, rolled with ice, and salted. During the year ending June 30, 1880, 18,833,330 lbs of oleomargarine were exported from New York, the greater part going to Holland The manufacture and sale of this substance is strongly condemned by many butter merchants, and as strongly recommended by various well-known American chemists Analyses given in the report show very small differences between oleomargarine and natural butter, except in the particular of soluble fats, of which oleomargarine contains considerably less than natural butter

THE Newcastle-upon Tyne Chemical Society publishes in its *Proceedings* a paper by R. Hasenclever, on the alkali manufacture in Germany in 1880, in which it is shown that the consumption of alkali in Germany at present exceeds the supply, and that manufacturers are now extending their works and building new ones. The ammonia process is coming largely into use, the cost of plant and expenses are less than when Leblanc's process is employed, but the latter process is also extending year by year.

A NEW journal, devoted to analytical chemistry, has just made its appearance with the title *Repertorium der analytischen Chemie*, it is published by Voss of Leipzig, and promises to be useful to those who are interested in this branch of applied science.

OBSERVATIONS on the production of crystalline albuminoid compounds have from time to time been published In a recent number of *Zeitschrift fur Krystallographie* a general account of these observations is given by Herr Schimper, and the following, among other, general statements are made albumenoid substances are capable of crystallising, but the crystals (or crystalloids, as they are called) differ from ordinary crystals in their

mode of growth, the angles of crystalloids are also probably somewhat variable. The crystalloids being chiefly regular and rhombohedral forms, some are compounds containing metals—chiefly magnesium, calcium, barium—others are free from metals The growth is connected in a definite manner with the crystalline form, the forms of the regular crystalloids remain unchanged, while the rhombohedral crystalloids undergo changes in their angles, the maximum growth being in the direction of the principal axis. The growth and solubility of the crystalloids are not equal throughout, they increase from without inwards, so that in dilute reagents the growth or the solution begins in the middle. The crystalloids are also frequently distinguished, like starch granules, by layers of unequal growth

HERR BALLO states in *Berliner Berichte* that if camphor be heated with a quantity of spirit of wine, containing from 36 to 65 per cent. ethylic alcohol, such that some of the camphor remains undissolved, fusion of the camphor occurs on the surface of the alcohol, and the melted camphor either floats on the surface of the alcoholic solution, or sinks to the bottom according to the specific gravity of the liquid.

IN reference to the observations of Hautefeuille and Chappuis regarding "pernitric acid," recently mentioned in these Notes, the following details may be of interest. If a perfectly dry mixture of oxygen and nitrogen is ozonised, and the absorption spectrum of a layer about two metres long of this mixture is observed, certain fine dark lines are noticed in the red, orange, and green, in addition to the characteristic absorption bands of ozone. These lines are not exhibited by nitrogen, nitrous anhydride, nitrogen tetroxide, or nitric anhydride, when submitted to the action of the electric discharge If the gas which exhibits the new lines be conducted through water, the water acquires an acid reaction, and the ozone bands alone remain in the spectrum If the gas be heated to redness the spectrum of nitrogen tetroxide appears If the gas be allowed to remain at ordinary temperatures the new lines gradually fade away, after twenty-four to forty-eight hours they have entirely disappeared, the spectrum of nitrogen tetroxide becomes gradually more prominent, and reaches a maximum after a few days The same lines are noticeable in the absorption-spectrum of the gas produced by the action of the electric discharge on a mixture of nitrogen tetroxide and oxygen The authors conclude that the newly-observed lines are due to the presence of an oxide of nitrogen containing relatively more oxygen than N_2O_5, *i e* to the anhydride of "pernitric acid"

METEOROLOGICAL NOTES

IN a paper on the "Marche des Isotherms au Printemps dans le Nord de l'Europe," Prof Hildebrandsson of Upsala Meteorological Observatory has struck out a fresh line of inquiry and produced results at once of great scientific and practical value In a series of five maps he shows the advances with season northwards over North-Western Europe of the isotherms of 32° 0, 37° 4, 42° 8, 48°·2, and 53° 6 respectively, the isotherms being thus 5° 4 (or 3° 0 C.) apart. On January 15 the isotherm of 32° 0 proceeds along the south coasts of the Black Sea and thence westwards to near Lyons, from which point it strikes northwards, passing into the North Sea at Groningen, and skirts the west of Norway as far as Christiansund The progress northwards and eastwards of this isotherm at the subsequent fortnightly epochs is extremely instructive, the advance northwards over the plains of Russia being manifoldly more rapid than its advance over the south-west of Norway. By May 1 the mean temperature of the whole of North Western Europe has risen above 32°·0 except a small portion from the North Cape to the White Sea In the height of summer the isotherm of 53° 6 (12° C.) reaches its northern limit, and then includes the whole of Europe except a thin slice of Norway from Vardo to the Lofoden Isles. Since on April 15 this isotherm skirts the southern shores of the Black Sea, its advance northwards is much more rapid than that of 32°·0. Specially instructive is it to note the influence of the various seas and mountain systems on the seasonal advance of the different isotherms. An interesting table is given showing the time taken by various natural phenomena to advance a degree of latitude northwards along the shores of the Baltic. The flowering of plants takes 4·3 days in advancing over a degree of latitude in April, 2·3 days in May, 1·5 days in June, and 0 5 days in July, the ripening of fruits generally 1 5 days; and the fall of forest leaves 2 3 days. Hence the phenomena are propagated with the greatest rapidity when the temperature approaches and reaches the annual maximum.

SOME months ago Miss Ormerod made a present to meteorologists of some value in her book entitled "The Cobham Journals," which gives an appreciative, well-written, and in some respects novel and ingenious account of the meteorological and phenological observations made by the late Miss Caroline Molesworth at Cobham, from 1825 to 1850. For each of the years complete tables are given of temperature, rainfall, and wind, which include also a comparative table for temperature and rain for Chiswick, taken from Glaisher's discussion of the Chiswick meteorological observations from 1826-69. Along with these tables are printed full notes setting forth the main features of the weather of each month, the month being divided into more or fewer sections, according to the number of types of weather which prevailed; and a detailed account of the accompanying phenomena of vegetation and animal life. In the general summary appended to the work the bearings of weather on plant and animal life are more specially dealt with, and a valuable table is given showing the dates of the flowering of plants, the leafing of trees, the ripening of fruits, and the arrival of birds. What is much to be admired in the work is the modesty, conscientiousness, and earnestness everywhere manifest, and these qualities of the scientific worker, it may be added, equally characterise the admirably planned and worked scheme of Observations of Injurious Insects the author is now conducting so successfully

AT the General Meeting of the Scottish Meteorological Society held on Friday last, Mr Buchan read a paper on the atmospheric pressure of the British Islands, based on the observations of the last twenty-four years at about 300 stations. The mean pressure of these Islands taken as a whole is very nearly 29 900 inches, this isobar crossing the country from Galway to Newcastle From this it rises southwards to 29 983 inches in the Channel Isles, and falls northward to 29·780 inches at North Unst in the extreme north of Shetland, there being thus a difference of about two-tenths of an inch of mean pressure between the extreme south and north. As regards individual stations the annual monthly maximum is attained in May, to the north of a line drawn from the mouth of the Shannon to the Wash, and thence round to Colchester, and the excess of this month's pressure is the greater as we advance north-westwards to the Hebrides, it is greatest in July over the extreme south of Ireland and the extreme south west of England, but elsewhere the highest monthly mean is in June The maximum in May over the whole of the northern portion of these Islands is connected with the maximum during the same month over arctic and sub-arctic North Atlantic, and regions adjoining, and the maximum in July over the south west is connected with the high pressure which obtains in this month over the Atlantic between Africa and the United States The July pressure of the south-east of England is lowered from its proximity to the Continent, where pressure falls to the minimum in July. The mean monthly minimum occurs in January everywhere to the north of a line from Galway to Berwick, in March to the east of a line from Hull to Osborne, and in October over the rest of England and Ireland, which thus includes the larger portion of the British Islands. Of these depressions in the annual march of the pressure, by far the largest is the January one, which in the Outer Hebrides falls to 0 080 inch below the mean of any other month It is there accordingly where the great diminution of pressure in the north of the Atlantic during the winter month is most felt. The greatest difference between the extreme north and south, amounting to nearly 0 400 inch, takes place in January, and it is in this month when the isobars lie most uniformly from west-south-west to east-north-east, thus giving the gradient for the south-westerly winds which prevail in this season The least variation occurs in May, the extremes being 30·002 inches in Scilly in the south, and 29 906 inches at North Unst in the north, being thus only a fourth part of the difference which obtains in January. The greatest divergence from parallelism among the isobars occurs in July, where the arrangement somewhat resembles a fan with the hand part in the west of Ireland, and the lines opening out to their greatest extent in the east of Great Britain—a disposition of the lines due to the position of Great Britain between the high pressure which at this season overspreads the Atlantic to the south-west, and the low pressure which is so characteristic a feature of the meteorology of the old Continent in summer.

THE temperature of January last was of a character sufficiently striking and unusual as to call for a permanent record in ou

pages Lower mean temperatures of particular months have occurred previously in Shetland, Orkney, and the extreme north of Caithness and Sutherland, January, 1867, having been colder in these northern regions Other months, notably February, 1855, were as cold as, or colder than, January last over England generally except its north western counties. But in this latter district and over the whole of the rest of Scotland January was colder than any month on record, going back for the different districts on observations which extend over periods varying from 24 to 118 years. The mean temperature fell below that of any previously recorded month in varied amounts up to 4°·0, this excessive degree of cold being experienced chiefly in the upper narrow valleys of the interior of the country, such as Lairg in Sutherland, Upper Deeside, and Tweeddale, and the uplying valleys of the Cheviots The greatest absolute cold occurred on the nights immediately preceding the great London storm of the 18th, the lowest, so far as the facts have reached us, being −16°·0 near Kelso, −15°·0 at Stobo Castle in Peeblesshire, −13°·0 at Paxton House near Berwick, −11°·0 at Lairg, and Thirlestane Castle near Lauder; and −8°·0 at Milne Graden near Coldstream This depression of temperature thus equalled that of the memorable night of December 4, 1879, when it fell, at Springwood Park near Kelso, to −16°·0, which is absolutely the lowest authentic temperature that has been recorded in Great Britain since thermometers came into use, leaving out of view as incomparable and misleading all observations made with exposed thermometers In Scotland, the mean temperature of each of the five months ending with February was under the average, the depression being greatest just where as stated above the cold of January was greatest The mean temperature of these five months was 5°·6 under the average in West Perthshire, 5°·0 at Lanark, 4°·5 at Thirlestane Castle, Braemar, and Culloden, and about 3°·0 in the west from North Unst to the Solway Firth In South Britain, the mean temperature of this period did not fall so low owing to the milder weather there during November and December The snowstorms of this winter are, at least, equally memorable, particularly the great storm of the third week of January in the south of England, and the great storm in Scotland in the first week of March, when railway traffic was paralysed, many trains being buried under snow-wreaths twenty, thirty, and even in some cases forty feet in thickness

THE OXFORD UNIVERSITY COMMISSIONERS AND THE PROFESSORIATE

THE University Commissioners have issued a revised edition of the proposed statutes on the professoriate The scheme laid before the Hebdomadal Council last November met with considerable opposition, which resulted in representations being made by the Council to the Commissioners in favour of certain modifications in the duties assigned to the professors. On comparing the revised with the old proposals, it is evident that the Commissioners have become convinced that it is desirable to allow each professor a larger individual liberty in the mode of giving instruction in his department than was granted in the former scheme. In the General Regulations of last November Clauses 4 and 5 ran as follows.—

4 During the period of each term over which his course of lectures shall extend, and on so many days in the week as the particular regulations applicable to his chair require, he shall be ready to give private instruction to such students, being members of the university and attending his lectures, as may desire to receive it, in such matters relevant to the subjects of his lectures as may more conveniently be explained in that manner, and also to test by questions or otherwise, as may be convenient, the knowledge of such students in those subjects. Such private instruction shall be open without fee to students who are members of a college out of the revenues of which his chair is wholly or partly endowed, and to other students on payment of such fees (if any) as the professor may require, not exceeding in number or amount the limit set by any statutes of the university in that behalf which may be in force for the time being

5. At the end of each term in which he has delivered lectures he shall examine the students who have attended them, and shall, on the request of the head of any college, inform the college of the results of the examination as regards the students who are members of such college, and shall also, if requested, give like information to the Delegates of students not attached to any college or hall.

In the new statutes the obligation to examine the whole class is removed, but each professor at the head of a laboratory or observatory must inform the college authorities of the regularity and proficiency of students attending his department. The new general regulations run as follow :—

Duties of Professors

1. It shall be the duty of every professor in his department to give instruction to students, assist the pursuit of knowledge, and contribute to the advancement of it, and aid generally the work of the university.

2 Every professor shall in respect of the lectures to be given by him conform to the particular regulations applicable to his chair He may lecture in such manner and form as he judges to be best for the instruction of students and the advancement of knowledge

3. It shall be his duty to give to students attending his ordinary lectures assistance in their studies by advice, by informal instruction, by occasional or periodical examination, and otherwise, as he may judge to be expedient For receiving students who desire such assistance he shall appoint stated times in every week in which he lectures

4 At the request of any student who has regularly attended any course of lectures he shall certify in writing the fact of such attendance

5 The ordinary lectures of every professor shall be open to all students who are members of the university without payment of any fee, unless the university shall otherwise determine. But the university may, if it should deem it expedient so to do, by statute or decree authorise any professor to require payment of fees not exceeding a specified amount in respect of all or any of his lectures or of the instruction to be given by him

6. Every professor shall in addition to his ordinary lectures deliver from time to time, after previous public notice, a public lecture or lectures to be open to all members of the university without payment of any fee

With regard to the manner of election to professorships and to the dispensations and leave of absence granted by the visitatorial boards, little or no alterations have been made The professoriate is divided into three schedules With the exception of the professors of geology, mineralogy, and botany who come under Schedule B, the professors in the different departments of natural science come under Schedule C, to which division the following particular regulations are applicable :—

(*a*) The professor shall reside within the university during six months at least in each academical year, between the first day of September and the ensuing first day of July

(*b*) He shall lecture in two at least of the three university terms. His lectures shall extend over a period not less in any term than six weeks, and not less in the whole than fourteen weeks, and he shall lecture twice at least in each week

(*c*) The laboratory under the charge of each professor, and in the case of the Savilian Professor of Astronomy, the University Observatory, shall be open for eight weeks in each term, and at such other times and for such hours as the university may by statute determine

Students shall be admitted to the university observatory, and to the laboratory under the charge of each professor, upon such conditions as the university shall from time to time by statute determine, and upon the terms of paying such fees, not exceeding such amount as may be fixed by any statute of the university in force for the time being, as the professor may from time to time require.

(*d*) Except for some grave reason to be approved by the Vice-Chancellor, the professor shall, for seven weeks in each term, and during some part of three days in each week, be ready to give instruction in the subject of his chair to such students as shall have been admitted to the laboratory under his charge (or in the case of the Savilian Professor of Astronomy, to the University Observatory), and such instruction shall be given in the laboratory or observatory (as the case may be) or in some class-room connected therewith

(*e*) The professor shall also, at the close of each term, inform any college which may request him to do so as to the regularity of attendance and the proficiency of the students belonging to such college who have been admitted into the laboratory or observatory under his charge, and shall give like information, if requested, to the Delegates of students not attached to any college or hall

4. The particular regulations next following shall be applicable to the several professors named in them respectively (that is to say)—

(a) The Savilian Professor of Astronomy shall have the charge of the University Observatory, and shall undertake the personal and regular supervision of the same, and of the several demonstrators and other assistants employed therein, and shall be responsible for all the work carried on there.

(b) The Professor of Experimental Philosophy shall have the charge of the Clarendon Laboratory, and shall undertake the personal and regular supervision of the same, and of the several demonstrators and other assistants employed therein, and shall be responsible for all the work carried on there

(c) The Waynflete Professor of Chemistry shall have the charge of the chemical laboratories in the University Museum, or such part thereof as the university may by statute assign to him, and shall undertake the personal and regular supervision of the same, and of the several demonstrators and other assistants employed therein, and shall be responsible for all the work carried on there.

(d) The Linacre Professor of Human and Comparative Anatomy shall have the charge of the anatomical and ethnological collections and the anatomical laboratories in the University Museum, or such part thereof as the university may by statute assign to him, and shall undertake the personal and regular supervision of the same and of the several demonstrators and other assistants employed therein, and shall be responsible for all the work carried on there.

(e) The Professor of Botany and Rural Economy shall have the charge and supervision of the Botanical Gardens and botanical collections belonging to the university, and it shall be part of his duty to make such gardens and collections accessible to, and available for the instruction of, students attending his lectures

(f) The Professors of Geology and Mineralogy respectively shall have the charge and supervision of the geological and palæontological collections and of the mineralogical collection belonging to the university, and it shall be part of their duties to make such collections respectively accessible to, and available for the instruction of, students attending their lectures

To the class of teachers to be called University Readers some of the duties assigned to the professoriate under the old scheme are now transferred The "informal instruction" twice a week to all students who may demand it becomes now part of the regular duty of the Reader, and not of the Professor The following are the most important clauses on University Readers —

(a) Every appointment of a University Reader shall be made by the Delegates of the Common University Fund, or by persons, not fewer than three in number, nominated for that purpose by the Delegates

(b) Every University Reader shall hold his office for five years, but shall be re-eligible

(c) He shall receive from the Common University Fund 300*l*. per annum.

(d) He shall in every year lecture in each of the three University Terms (Easter and Trinity Terms being counted as one). His lectures shall extend over a period not less than seven weeks in each term, nor than twenty-one weeks in the whole, and he shall lecture twice at least in each week. In addition to these lectures he shall, twice at least in every week in which he lectures, receive students desirous of informal instruction and other assistance in the studies with which his readership is connected.

(e) He may require from students receiving the informal instruction and assistance mentioned in the foregoing regulation payment of a fee not exceeding 2*l* for any university term. With this exception his lectures shall be open to all members of the university without payment of any fee.

5. It shall be the duty of every reader to lecture and give instruction in the subject or branch of study for which he is appointed, and in arranging the subjects and times of his lectures it shall also be his duty to have regard to the arrangements made or proposed to be made by the professors, if any, lecturing in the same department of study

The most important change in the new scheme is the liberation of the professor and reader from the immediate control of the council or board of his faculty Under the old scheme each professor and reader was obliged during Easter term to send in to the faculty a schedule of all his lectures and other instruction for the ensuing year, giving the days, hours, and subjects of the lectures The faculty was to have the power of criticising the schedules and of recommending alterations, and the two following clauses were intended to reduce a refractory professor to submission :—

14. The Council shall not alter any schedule without the consent of the person named in it. But if a recommendation made by the Council as to any schedule be not acceded to, the Council may, if they think fit, exclude the schedule or the part of it affected by such recommendation from the list, unless such schedule was sent in by a Professor or University Reader. In the last mentioned case the Council shall not exclude the schedule, but may, if they think fit, report the fact to the Vice-Chancellor, who shall lay the report before the Visitatorial Board.

15 If a Professor or University Reader wilfully neglect to send in schedules of his lectures, the Visitatorial Board may, on a report of the Council of the Faculty, and without any charge laid before the board, proceed against him by admonition or otherwise as for a neglect of the duties of his office Refusal on the part of a Professor or University Reader to accede to any recommendation of the Council of his faculty respecting his lectures may likewise be treated by the board as a neglect of duty, if, on a consideration of the circumstances, the board be satisfied that such refusal was without reasonable justification. Provided that if the recommendation relate to the subjects of the proposed lectures it shall be sufficient for the Professor or University Reader to show that such lectures are in respect of their subject-matter a *bonâ fide* fulfilment of the statutory duties of his office.

The following are the new clauses which regulate the relation between the professoriate and the board in the different faculties of arts, theology, law, and natural science —

The board of each faculty shall have the following duties and powers :—

It shall be the duty of the board to prepare and send to the Vice-Chancellor for publication—

(a) Before the end of each term a list of the lectures which are to be given in the ensuing term in the subjects of the faculty under the authority of the university or of any college, or of the Delegates of students not attached to any college or hall, and are to be open to persons other than the members of any one college, or (as the case may be) other than the students not attached to any college or hall.

(b) In Easter or Trinity Term annually a general scheme or statement showing, as far as may be, the lectures to be given as aforesaid during the course of the ensuing academical year.

(c) In Michaelmas Term, or at such other time in each year as the university may by statute appoint, a summary statement of the lectures given during the preceding year in the subjects of the faculty by Professors and University Readers, and of all other lectures which have been advertised in the published lists of the faculty and given in conformity therewith. The board shall add to this statement such further information (if any) respecting the studies and instruction of the faculty as the university may by statute require, and may point out any deficiencies in the provision made for instruction, and make recommendations for supplying them

10. It shall be the duty of every Professor and University Reader to send to the Secretary of the Boards of Faculties timely notice of the lectures he proposes to give in any of the subjects of any faculty to which he belongs, pursuant to the statutes and regulations in force for the time being, and in arranging his lectures to have due and reasonable regard to the recommendations of the board of the faculty, but this duty shall not be deemed to preclude him from the free use of his discretion in selecting for his lectures any subject or part of a subject which he deems most advisable within the province assigned to him by statute.

GOLD IN NEWFOUNDLAND

REPORTS having been circulated for some time past that gold had been discovered in quartz veins in the regions near Brigus of Conception Bay, Newfoundland, Mr. Murray has recently made a personal examination of the ground.

In his report to the Governor of the Colony, dated October 8, he states that by the first blast from two to three cubic feet of rock were removed, all of which was carefully broken up, washed, and examined ; which operation finally resulted in the display of ten or twelve distinct "sights" of gold In one fragment about five pounds weight, largely charged with dark green chlorite, the gold shows itself in three places distinctly, while many small specks are perceptible by means of a good lens. The fracture of a fragment of milky white and translucent

quartz, which was broken off the large piece, revealed two patches of gold, both of which together, if removed from the matrix, would probably produce about a dwt (pennyweight) of the metal, whilst several small masses or nuggets were found adhering to the small broken fragments of quartz at the bottom of the pail in which the rock was washed, the largest of which contained about ten or twelve grains of gold. From some specimens in which no gold was perceptible to the naked eye, and had been selected for analysis, a small nugget weighing three grains was obtained in the dust of the bag in which the specimens were carried. In the specimen from Fox Hill the metal occurs thickly in the minutest specks, scarcely, if at all, perceptible to the naked eye, but readily recognised under the lens, where it chiefly surrounds a small patch of chlorite

The rock formation intersected by these auriferous quartz veins is of Huronian or Intermediate age, or the group of strata next below the *aspidella* slates of St John's The group consists chiefly of greenish fine-grained felsite slates, which, judging by the weathering of the exposed surfaces, are also magnesian and ferruginous The cleavage is exactly coincident with the bedding, and the slates occasionally split into very fine laminæ, but frequently into strong stout slabs, which are used to a considerable extent at Brigus for paving, for hearthstones, and for building foundations and walls.

A rough and hummocky belt of country from three-quarters to one mile wide, which forms the nucleus of the peninsula between Bay-de-Grave and Brigus Harbour, is thickly intersected by reticulating quartz veins varying in thickness from less than an inch to upwards of a foot, which often appear to ramify from a central boss or great mass of quartz, often extending over many square yards, and usually forming low isolated hummocks or hills The general run of the belt is as nearly as possible north-east and south-west from the true meridian. Although many of the veins, both small and large, may be seen for considerable distances to run exactly parallel with the bedding, the net-work of the whole mass runs obliquely to the strike of the beds, which are also minutely intersected by the smaller veins crossing and reticulating in all directions

The resemblance in general character of the strata with their included auriferous quartz veins in Newfoundland to those of Nova Scotia is striking, although according to Dr Dawson the auriferous country of Nova Scotia is probably of Lower Silurian age, while that of Newfoundland is undoubtedly unconformably below the Primordial group, which, with abundant characteristic fossils, skirts the shores of Conception Bay

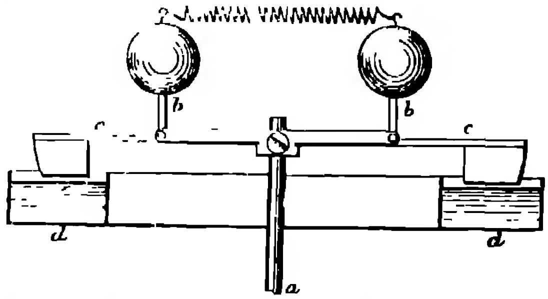
That a large area of country in the regions referred to is auriferous there can scarcely be a doubt, although nothing short of actual mining and practical experience can possibly prove what the value of the produce may be, or whether the prospects of obtaining a remunerative return for the necessary outlay are favourable or otherwise The specimens which have been obtained, although an unquestionable evidence of the presence of the precious metal, cannot by any means be taken as indicative of a certain average yield. An analysis of quartz collected, in which gold is imperceptible to the naked eye, may aid in revealing some evidence of its constancy, and may throw some light upon the possible average of superficial contents over certain areas under similar circumstances; but it may safely be predicted that the irregularities of distribution, so conspicuously displayed by the veins on the surface, will extend beneath it, and that it will be mainly on the stronger and more persistent bands, where intercalated with the strata, that mining will extend to any considerable depth.

The indications of gold in Newfoundland are certainly sufficiently favourable to merit a fair trial, and there are good reasons to hope and expect that ample capital applied to skilled and judicious labour may be found remunerative to future adventurers, while a new industry will be added to give employment to the labouring population of the island, and possibly bring this despised and but little-known colony into more prominence and consideration abroad than it hitherto has enjoyed.

A SPEED GOVERNOR FOR CONTINUOUS MOTION

IN NATURE, vol. xxiii. p. 61, a speed governor for a chronograph is described, the invention of the Astronomer-Royal, in which a conical pendulum acts on a paddle moving in a viscous fluid, so as to make it dip more deeply into the fluid when the speed is increased. A similar apparatus, with a spring instead of a pendulum, has recently been applied by me to a clock driving a recording seismograph whose motion is required to be continuous and fairly uniform As the apparatus is very simple and easily made, requiring no nice fitting, and has proved itself to be a very effective governor, a description of it may perhaps be useful.

a is a vertical spindle driven by the clock, and making about one turn per second Near the top of it a cross-bar is fixed, whose ends are forked, and in them are jointed two bell-crank levers *b c*, *b c*. At the top of *b b* are two masses, which in my instrument are two smooth-bore musket balls. These are tied together by a spiral spring between two hooks at the top. At the ends of *c c* are two flat paddles, and when the balls fly out from the axis of rotation the paddles dip into glycerine contained in the annular trough *d d*, which is shown in section The trough rests on the top of the clock frame. By using only one spring, instead of tying each ball to the spindle by a separate spring, I secure that the pull inwards is necessarily the same for both.



As the balls go out a component of their weight comes into action, helping this motion and opposed to the pull of the spring. For small displacements this force increases very nearly in proportion to the displacement, and hence, by choosing a spring of suitable stiffness, a small change of speed can be made to produce a relatively very large displacement, the proper condition for approximate isochronism

A governor whose actual size is about twice that of the sketch, roughly made in my laboratory, gives only a slight rise in speed when the driving weight is doubled, and works very smoothly. The apparatus can easily be applied to a clock, perhaps most easily by rolling contact between a horizontal disk on *a* and a vertical disk on one of the axles of the clock, and it gives sufficient control for many purposes If great accuracy were required the resultant effect of change of temperature on the elasticity of the spring and on the viscosity of the fluid might be corrected by making *c* of two metals, so as to bend and raise or lower the paddles It is well to put stops to prevent the balls from falling inwards beyond the vertical position. J A. EWING

The University, Tokio, Japan, January 21

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD —The electors to the Radcliffe Travelling Fellowship have, after examination, awarded the Fellowship to Mr A. J. Anderson, B.A , late Natural Science Demy of Magdalen College.

The examiners for the Burdett-Coutts (Geological) Scholarship have recommended Mr J. B Nias, B.A., scholar of Exeter College, for the scholarship.

The Junior Studentships in Natural Science at Christchurch have been awarded to Mr. G. C. Chambres, Commoner of Balliol College, and late of Dulwich School, and to Mr R. E. Moyle (private tuition). *Proxime accessit*, Mr. C. D Spencer, of Clifton College. Mr. W. C. Hudson was elected to an Exhibition in Natural Science.

The various lecturers and demonstrators in physics met last week at the instance of Prof. Clifton, and arranged a scheme of lectures for next term, similar to that carried out during the present term. The object of the scheme is to divide the subjects among the independent colleges and university lecturers, so that students may attend, by going from one lecturer to another, all the lectures required for any particular course of study.

THE annual meeting of the Governors of the City and Guilds of London Institute for the Advancement of Technical Educa-

tion was held on Monday at the Mercers' Hall, Sir S. Waterlow, M.P., one of the vice-presidents, in the chair. The most important points referred to in the report were the course taken in reference to the plans and estimates for the central institution, the settlement of the plans for the Technical College, and the technological examinations With regard to the central institution the Board thought it ought not to authorise the entering into any contract beyond that for which they had the money in hand. The Chairman earnestly hoped that some of the companies that had not yet contributed would subscribe and enable the 20,000*l* which was yet required to be made up. With reference to the Technical College at Finsbury there was no reason why the foundation stone of the building should not be laid at an early date He was glad to be able to state that the Drapers' Company had announced its intention of increasing its subscriptions from 2000*l* to 4000*l*. per annum, the additional sum to be applied for the first two years towards the cost of building and fitting the Finsbury Technical College. The Vintners' Company had likewise signified its intention of contributing 250*l* per annum, which showed its sympathy in the work During the past year the income had been 13,549*l*, and by the subscriptions received it was raised to 20,765*l*. for the year 1881. The chairman concluded by moving the adoption of the report Mr. W. Spottiswoode seconded the motion, which was unanimously carried.

AT a meeting held at 68, Grosvenor Street, W, on February 18, Mr. George Palmer, M P, in the chair, it was decided to raise a fund for the purpose of founding an annual prize or scholarship for mathematics in memory of Miss Ellen Watson, to be open for competition equally by men and women, at either University College or the London University. Miss Watson was the first woman to enter the classes of mathematics at University College, London Her success as a student of mathematics was brilliant, and at the end of the session, in June, 1877, she gained the Mayer de Rothschild Exhibition, which is awarded annually to the most distinguished mathematical student of the year After passing the 1st B Sc examination at the London University, in July, 1879, Miss Watson was obliged by failing health to leave England for Grahamstown, South Africa, where she died last December, aged twenty-four years. It may be added that the Ellen Watson scholarship, or prize, would be the first that has been founded in memory of a woman's mathematical genius and promise of scientific work A second meeting to determine to which of the above institutions the scholarship should be offered, and to arrange other matters in connection with it, was held yesterday. Subscriptions will be gladly received and may be paid to Miss Alice M Palmer, hon sec, 68, Grosvenor Street, W., or to the account of the "Ellen Watson Fund," Messrs. Dimsdale and Co., Bankers, Cornhill, E.C.

PRINCE LEOPOLD will formally open the new University buildings at Nottingham on Thursday, June 30.

AT a meeting of the Council of the Wilts and Hants Agricultural College, at Downton, Salisbury, on Wednesday, it was unanimously resolved that the College should henceforth be called the College of Agriculture.

SCIENTIFIC SERIALS

Annalen der Physik und Chemie, No. 2—On absorption of carbonic acid by wood charcoal, and its relation to pressure and temperature, by P. Chappuis—On absorption of dark heat rays in gases and vapours, by E Lecher and J Pernter.—New researches on Newton's rings (continued), by L. Sohncke and A. Wangerin.—On the discharge of electricity in rarefied gases (continued), by E. Goldstein.—On the question as to the nature of galvanic polarisation, by F Exner.—On the same, by W. Beetz.—On excitation of electricity on contact of metals and gases, by F. Schulze-Berge.—Note on F. Exner's paper on the theory of Volta's fundamental experiment, by the same

Bulletin de l'Académie Royale des Sciences (de Belgique), No 1. —Geodetic junction of Spain and Algeria in 1879, by M. Perrier. —Fire-damp and atmospheric perturbations, by M. Cornet.—On the excretory apparatus of rhabdocœlan and dendrocœlan Turbellaria, by M. Fancotte.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti, vol. xiv, fasc. i and ii.—Synoptic tables of results obtained in the Botanical Garden of Pavia University from cultivation of fifteen qualities of vine (Asiatic and American species and varieties), by S. Giacomo.—Contribution to the pathology of voluntary muscles, by C. Golgi—Contribution to the physiology of strychnic tetanus, by G. Ciniselli.—On Cremonian correspondences in the plane and in space, by C. F. Archieri.—The invasion by the *Peronospora viticola* in Italy, by S. Garovaglio.—On the damage which Peronospora may do in Italy in future, by V. Trevisan.—Statistical note on inflammation, on cancer, on cirrhosis, on tuberculosis, and on pyæmia, by G. Sangalli—Proposed classification of the stature of the human body, by S. Zoja.

Atti della R Accademia dei Lincei, vol. v. fasc. 2 (December 18, 1880)—Reports on prize competitions

Fasc 3 (January 2).—Contributions to the study of medullated nerve fibre and observations on amylaceous corpuscles in the brain and spinal cord, by A. Ceci—On the bacillus of contagious mollusca, by M. Domenico.—On an equation between the partial derivatives of the inverse distances of three planets which attract one another, by Dr. G. Annibale.—Two small fossil hymenoptera of Sicilian amber, by G Mulfatti—On some rare species of Italian birds, by P Luigi—On Stilbite from Miage (Monte Bianco), by C. Alfonso.—On ollenite, an amphibolic rock of Mount Ollen, by the same

Rivista Scientifico-Industriale, No. 2, January 31—Coglievina's centigrade photometer, by R Ferrini.

Memoirs of the St. Petersburg Society of Naturalists—The last volume of the *Memoirs* of the St Petersburg Society of Naturalists contains, besides the minutes of meetings of the Society, a most interesting paper by Prof Kessler, on the "Law of Mutual Help," or sociability, which he proves to be the necessary complement of Darwin's law of the struggle for existence—Ornithological observations in Transcaucasia, by M Mikhailovsky—Observations on the motions of diatomaceæ and their causes, by M K Merejkovsky.—Materials for the knowledge of the infusorial fauna of the Black Sea, by the same author—A sketch of the flora of the province of Toula, by MM D. Kojevnikoff and W. Tzinger, with a map—Figures showing the quantities of gases in the blood and the quantities of urea and urine secreted by man under various conditions of life, by M. Shitz, and a paper on Medusæ, by M K Merejkovsky.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, February 3—Dr. Klein communicated a paper by John Haycraft, Senior Physiological Demonstrator in the University of Edinburgh, on the cause of the striation of voluntary muscular fibre. The author showed that all the cross striæ observed are due not to any differences of structure along the fibre, but simply to the shape of the fibre itself The fibre is not a smooth cylinder, but is ampullated, alternate ridges and depressions occurring with beautiful regularity across its length The striæ correspond with these in position, and are caused by their action on the transmitted light. He showed theoretically how this must be so, and illustrated it with a model of the same shape but of uniform structure, which exhibited down to the minutest detail the cross striæ seen in the muscle itself He then showed the true explanation of the action of staining agents and of polarised light.

Mathematical Society, March 10—S Roberts, F.R.S, president, in the chair—Prof Cayley read a paper on the equilibrium and flexure of a skew surface—Mr. Tucker communicated portions of papers, viz.:—An application of elliptic functions to the nodal cubic, by Mr. R A Roberts, and note on Prof C. S. Peirce's probability notation of 1867, by Mr. H. McColl—Mr. J W L Glaisher, F R S. (vice-president), having taken the chair, the president communicated the following direct analogue in space of the well-known plane theorem, "If we take an arbitrary point on each side of a triangle and describe a circle through each vertex and the two points on adjacent sides, the three circles meet in a point," viz. if we take an arbitrary point on each edge of a tetrahedron and describe a sphere through each vertex and the three points on adjacent edges, the four spheres meet in a point The analogue was used as a point of departure for the study of four spheres meeting in a point.

Chemical Society, March 3.—Prof Roscoe, president, in the chair—The following papers were read:—On the action of Bacteria on various gases, by F. Hatton. An aqueous extract of flesh was used as the source of the Bacteria-containing liquid. A small flask half full of this liquid and half full of

mercury was inverted in mercury. The gas was then passed up In the case of atmospheric air a large absorption of oxygen was observed The other gases experimented with were hydrogen, oxygen, carbon monoxide, cyanogen, sulphur dioxide, nitrogen, nitrous oxide, nitric oxide, carbon dioxide, and coal-gas, in all cases the Bacteria remained alive and (except with cyanogen) flourished well. Acetylene, salicylic acid, strychnia (10 per cent), morphine, narcotin, and brucin were equally without effect on the Bacteria. Spongy iron, phenol, and alcohol were very destructive to these organisms —On the influence of intermittent filtration through sand and spongy iron on animal and vegetable matters dissolved in water, and on the reduction of nitrates by sewage, by Mr. F Hatton In the case of peaty water some diminution was observed in the organic carbon, but none in the organic nitrogen Sewage promotes the reduction of nitrates Spongy iron converts nitrates into ammonia and free nitrogen —Prof Tidy then read a lengthy paper on river-water This is a reply to the criticisms of Dr Frankland and Miss Lucy Halcrow on a former paper by the author In the present paper the author restates his firm conviction that a fairly rapid river, having received sewage in quantity not exceeding one-twentieth of its volume, regains its purity after the run of a few miles, and becomes wholesome and good for drinking —On β diquinoline, by F. Japp, Ph.D., and C Colborne Graham This substance was obtained by heating quinoline and benzoyl chloride in sealed tubes to 240°–250° C, it gave on analysis the formula $C_{18}H_{12}N_2$, it crystallises in colourless satiny laminæ, and fuses at 191° C.

Anthropological Institute, February 22 —F W Rudler, F G S., vice-president, in the chair —The election of F E Robinson was announced —A paper on arrow poisons prepared by some North American Indians, by W J Hoffman, M D, was read. The information was obtained from prominent Indian chiefs who visited Washington in 1880, and the tribes alluded to in the paper were the Shoshoni and Banak, Pai ute, Comanche, Lipan Apache, and Sisseton Dakota, this last tribe have a method of poisoning bullets by drilling four small holes at equal distances around the horizontal circumference and filling the cavities with the cuticle scraped from a branch of cactus (*Opuntia missouriense*), the projecting rim of metal caused by the drilling is then pressed over the scrapings to prevent their being rubbed off or lost As the opuntia is a harmless plant, the idea of poison is evidently suggested by the pain experienced when carelessly handling the plant, which is covered with barbed spines —A paper by David Christison, M D, on the Gauchos of San Jorge, Central Uruguay, was read Having given a description of the country and a history of the people, the author remarked that it had often been a matter for surprise that Englishmen should be able to live safely among a turbulent race of people such as the Gauchos, but our countrymen, when placed in a higher sphere and independent of their political or private feuds, ran little risk in ordinary times, moreover here, as elsewhere, the innate capacity of the British for managing semi-barbarous races by a combination of fair dealing and kindness was conspicuously manifested The Englishman had acquired a certain liking for the Gauchos which grew rather than diminished with time. The Gaucho could not be a permanent type, and in the Banda Oriental was rapidly being modified. The more strict definition and sub-division of property, the increase of sheep-farming and change in the management of cattle to the tame system, the rapid extension of wire fencing, and the introduction of agriculture, conspired to cramp his movements and to do away with the necessity for his peculiar accomplishments It was even to be feared that he himself would pass away, and that the race which ultimately possesses the Campos will show but slight traces of his blood or of the aboriginal Indian race which he represents The great mortality from murder and homicide which the place was noted for was increased by the numbers who perished under quack doctors. The Gauchos had been badly governed, and much of the evil in them was due to this cause.

Entomological Society, March 2 —H T Stainton, F.R.S., president, in the chair —Mr. E. A. Fitch exhibited a specimen of *Strangalia 4 fasciata*, taken at West Wickham by Mr A S. Olliff last August.—Mr. W. C. Boyd exhibited a specimen of *Nonagria lutosa*, taken outside the Great Eastern terminus at Liverpool Street, and a curious variety of *Ennomos tiliaria* from Cheshunt.—Mr. W. F. Kirby called attention to a general illustrated work on insects on which Herr Buckecher of Munich is engaged, and laid specimens before the meeting —The following papers were then read .—Mr. F P. Pascoe, On the genus *Hilipus* and its neotropical allies.—Mr W L Distant, Descriptions of new genera and species of *Rhynchota* from Madagascar —Prof J O Westwood, Observations on the hymenopterous genus *Scleroderma* and some other allied groups —Mr McLachlan then called the attention of members to an important paper by Dr Adler on the dimorphism of oak-gall flies (*Cynipidæ*), which has just been published in Siebold and Kolliker's *Zeitschrift fur wissenschaftliche Zoologie*, vol xxxv.—Mr E. A. Fitch read a report from the *Western Daily Mercury* of the trial which has lately taken place at Yeahampton (South Devon) in reference to the possession of living specimens of the Colorado potato beetle by a farmer who had brought them from Canada.

Institution of Civil Engineers, March 1 —Mr Abernethy, F R S E, president, in the chair —The paper read was on the tide-gauge, tidal harmonic analyser, and tide predicter, by Sir William Thomson, LL.D, F R.SS L and E

EDINBURGH

Royal Society, February 21 —Prof Fleeming Jenkin in the chair —Sir William Thomson communicated a paper by Mr. Witkowski on the effect of strain on electric conductivity A cylindrical brass tube, with a magnet and attached mirror suspended horizontally in the centre at right angles to the axis, was traversed from end to end by an electric current In its original unstrained isotropic condition the cylinder so conducted the current that the inclosed magnet was unaffected A couple was then applied in a plane at right angles to the axis, so as to distort the metal tube by a definite twist, thus rendering it ædotropic as regards its electrical conductivity, and giving to the current a spiral set, which was evidenced by the deflection of the suspended magnet. The lines of flow set spirally round in a direction contrary to that of the applied couple—a result in complete accordance with the theory of twists, which requires a lengthening (and therefore an increase of resistance) along spiral lines that set round with the couple and a simultaneous compression (and corresponding decrease of resistance) along lines at right angles to these. Quantitative results were obtained by balancing the electro-magnetic action of the current in the strained tube by means of an external circular movable conductor traversed by a steady current —Sir William Thomson described certain experiments which he had lately made on the effect of moistening the opposing surfaces in a Volta condenser, and of substituting a water-arc for a metallic arc in the determining contact The main features of the paper were, the non-existence of any measurable difference of potential when contact was made by means of a drop of clean water between opposed polished surfaces of zinc and copper, the effect of oxidising the surfaces in the pure metallic contact experiment, and the exact similarity in the action of dry polished zinc and wet oxidised zinc when opposed to dry copper and brought into contact by a metallic arc Sir William also described the "vortex sponge" A vortex column spinning at the heart of a mass of fluid revolving irrotationally inside an imperfectly elastic cylindrical case forms a system in a position of maximum energy, and any slight disturbance from the truly circular rotation of the vortex core results in a gradual drawing off of energy, in virtue of the imperfectly elastic character of the bounding material, until the system assumes its position of minimum energy with the rotationally-revolving fluid on the immediate inner surface of the inclosing case and altogether surrounding the irrotational fluid, which is now in a state of quiescence The intermediate stages between these first and last conditions are what Sir William Thomson characterises by the name of vortex sponge —Mr. T Muir presented a paper on continuants, to which special form of determinant he could, by suitable transformations, reduce any given determinant of ordinary type, and so was able to express a determinant as a continued fraction —Prof. Chrystal added a note on this paper showing how in the most general case n equations between n unknown quantities can be made to yield by suitable elimination n other equations, in no one of which more than three terms appear, so that a continuant form of determinant is got which bears a simple relation to the determinant formed by the coefficients of the original equations.

MANCHESTER

Literary and Philosophical Society, November 9, 1880.—E. W. Binney, F.R.S, F G S., president, in the chair.—On gravitation, by the Rev Thomas Mackereth, F R A.S

December 28, 1880.—E W Binney, F R S, president, in

the chair.—The literary history of Parnell's "Hermit," by William E. A. Axon, M R S L

February 22, 1881.—E. W Binney, F R.S , president, in the chair.—The president reminded the members present that yesterday was the hundredth anniversary of the first meeting of the Society —Dr. Balfour Stewart, F R S , communicated a letter from Mr. Herman Hager containing notes from Schultz' "Das hofische Leben" with regard to severe winters and famines from 1100 to 1315 —Ozone and the rate of mortality at Southport during the nine years, 1872-1880, by Joseph Baxendell, F R A S

PARIS

Academy of Sciences, March 7 —M Wurtz in the chair —The following papers were read —On observations of contact during the transit of Venus of December 8, 1874, by M Puiseux. He is led to divide the nine French observers into two groups (of six and three respectively), there being a marked difference between them in the way of estimating the hour of a contact Hence the necessity of a sort of common education, ensuring that observers work in the same way —On the reciprocal displacements of hydracids, by M Berthelot.—Spiral cells of very great length, by M Trécul By macerating, in water, the leaves of certain *Crinum* he found cells from 5 mm. to 13 40 mm. long.—Note on photography of the ashy light of the moon, by M Janssen He presented a photograph showing that part of the moon illuminated by light from the earth. The exposure was for 60 seconds. The moon was three days old The general figure of the lunar continents can be made out With photography the interesting phenomena in the double reflection of solar light, under varying circumstances, may be more exactly studied.—On the presence of trichinæ in pork of American importation, by M. Bouley Infection of this pork with trichinæ has probably long been a fact, though observed more lately Trichinosis is little known in France, thanks to the culinary habits of the people M Bouley was sent to Havre to see if a sanitary service of inspection, sufficient for the public hygiene, could be organised He recommends the initiating of a number of children and young girls in microscopical preparations, for assistance of the meat-inspector to make his examination with the necessary despatch. Should this plan succeed the prohibition of American pork will probably cease —On the presence of alcohol in the ground, in water, and in the atmosphere, by M Muntz. He has developed the method depending on the change of alcohol into iodoform, so that one-millionth of alcohol in water can be detected Alcohol is found in all natural waters except very pure spring water, also (and more of it) in snow Rain water and Seine water contain about 1 gr per cubic metre Alcohol no doubt also exists as vapour in the air. In soils, especially those rich in organic matters, there is a considerable quantity. The destruction of organic matter by various agents of fermentation accounts for the wide diffusion of alcohol in nature.—Observation of solar spots, faculæ, and protuberances at the observatory of the Roman College during the last quarter of 1880, by P Tacchini There was a progressive diminution of frequency of spots The maximum of faculæ of September extended into October The minimum of extension and height of protuberances fell in October, as well as the minimum of size of spots For spots and faculæ the maximum frequence was in the same zones as the previous quarter, viz , $\pm 10°$ $\pm 30°$ For protuberances the two maxima are not symmetrical We are still far from the maximum of solar activity.—Observations of the moon and of Jupiter's satellites at Algiers Observatory during the last quarter of 1880, by M Trepied M Mouchez, in presenting these, the first, astronomical observations from Algiers (where only a little meteorology has been done hitherto), said M. Tripied had lately gone from Montsouris to take charge, and felicitated the Academy on having observations of the moon, &c., in the Algerian climate —On the algebraic integration of an equation similar to the equation of Euler, by M. Picard —The formula of interpolation of M. Hermite expressed algebraically, by M Schering —On a general reason, justifying synthetically the use of the various developments of arbitrary functions employed in mathematical physics, by M Boussinesq —On an integrator, by M Abdank-Abakanowicz.—On circular double refraction and the normal production of the three systems of fringes of circular rays, by M. Croullebois.—On the enlargement of hydrogen lines, by M Fievez. He finds from experiment (with Geissler tubes) that the enlargement is correlative to rise of temperature. Thus the temperature of one heavenly body is higher than another when its hydrogen lines are wider and more nebulous. This agrees with the ideas of Huggins and Vogel.—On some phenomena of optics and vision, by M. Trève. Both in vision and in photography it appears that light is propagated with more intensity through a horizontal than through a vertical slit.—On the solubility of chloride of silver in hydrochloric acid in presence of water, or of little soluble metallic chlorides, by MM Ruyssen and Varenne —On the heat liberated in combustion of some substances of the saturated fatty series, by M Louguinine.—On the transformation of glucose into dextrine, by MM Musculus and Meyer —On an active amylamine, by M Plimpton.—On active propylglycol, by M. le Bel —On the winter of 1879-80 in the Sahara, and on the Saharan climate, by M Rolland The winter was exceptional. North-east and north winds prevailed The mean temperature from January 17 to April 16, between 35° and 30° lat , was only 14° 1 ; the extremes −4° 7 in the night of January 17-18, and 31° 1 on April 13 in the day. Rain fell several times in the Algerian Sahara, and abundantly in the end of January. It comes generally at intervals of over ten years. The Saharan climate seems to have degraded The region had probably at one time a larger population —M Melsens showed in a letter the economy realised by his lightning-conductors.—M. Zenger presented a photograph of the sun taken at Prague during total eclipse, in a very clear sky.

VIENNA

Imperial Academy of Sciences, March 10 —L T Fitzinger in the chair.—Dr P Weselsky and Dr R. Benedikt, on the influence of nitrous acid on pyrogallic acid —T H. Tanovsky, on a new azosulfobenzoic acid —Dominico Coglievina, on the Centigrade-photometer, a new optical instrument for determining the intensity of any source of light —Dr M. Buchner, analysis of the water from the "Lindenbrunnen," at Zlatten, near Pernegg (Styria).—Dr Max Margulies, on the determination of the coefficients of friction and sliding by the plane motions of a fluid —Dr T. Kreuz, on the development of the lenticells in the shadowed branches of *Ampelopsis hederacea*, Mels —Dr Hann, on the daily course of the meteorological elements on the plateau of the Rocky Mountains. —T B Heindl, on crystalline combinations of chloride of calcium with alcohols —Dr T Herzig, on the influence of sulphuric acid on mono- di and tribromo benzol —Alex Lustig, on the determinations of nerves in the smooth muscles —F. Toula, report on his geological researches in the western regions of the Balkans.

Imperial Institute of Geology, March 1.—R. M Paul, on the occurrence of petroleum in Wallachia —Dr. E Tietze, on some detritus-formations on the southern slope of the Persian Albur Mountain —Dr. V. Hilber, exhibition of geological maps of Eastern Gallicia

CONTENTS

THURSDAY, MARCH 24, 1881

MACQUORN RANKINE'S SCIENTIFIC PAPERS

Miscellaneous Scientific Papers by W. J. Macquorn Rankine, C.E., LL.D., F.R.S., late Regius Professor of Civil Engineering and Mechanics in the University of Glasgow. From the Transactions and Proceedings of the Royal and other Scientific and Philosophical Societies and the Scientific Journals. With a Memoir of the Author by P. G. Tait, M.A., Professor of Natural Philosophy in the University of Edinburgh. Edited by W. J. Millar, C.E., Secretary to the Institute of Shipbuilders in Scotland. With Portrait, Plates, and Diagrams. (London: Charles Griffin and Co., 1881.)

THE volume before us contains thirty-seven papers of rare scientific interest written by the late Prof. Rankine, who died now eight years ago. As to the cause of this long interval the Editor gives us no hint, nor is there anything in the volume to explain it. All the papers are reprints, without note or comment, except such as is contained in the concise but extremely graceful Memoir. These papers are not by any means all Rankine's original works. They are principally those relating to Thermodynamics and Hydrodynamics. There are however two important papers on the latter subject which are not contained in the volume ("On Stream Lines," *Philosophical Magazine*, 1865, "On the Mathecal Theory of Stream Lines," *Phil. Trans.* Royal Society, 1871). These can hardly have been omitted by design, as in the very last paper contained in the volume the author resumes the subject, directing attention to his paper of 1865, while the paper of 1871 is the most general and important paper Rankine wrote on this subject, besides being his last work.

The first twenty-seven papers contain the development by Rankine of that most modern of mathematical sciences, Thermodynamics, from its foundation-stone to the complete edifice as it exists at the present day. This by no means constitutes Rankine's entire work, nor do we think it his most useful work. But it is the largest gem in the casket, and should he be forgotten in all the rest this alone will secure for him a foremost place amongst those who have left their mark on philosophy.

The rapidity of the development of this branch of science is unrivalled. As profound as anything ever brought to light by the power of reason, it only occupied Rankine four years from the publication of his first paper until the theory was completed and applied to all cases. That the burning of coal was necessary to the production of steam, which was necessary for the working of an engine, and that the proportion of coal burnt bore some relation to the work done, were facts which for 200 years had been forcing themselves into notice, and gradually there had come to be an idea that in some way heat was the same thing as other forms of mechanical energy. But this was all, till, in 1843, Dr. Joule published his first experimental determination of the mechanical equivalent of heat. Published in an obscure way, it was some years before this novel but definite relation between heat and energy excited notice. The first published notice is by Thomson in 1849, although that Rankine had known it for some time previously is shown by the first of these papers, published in July of that year. In December of the same year Rankine sent in the Papers III. and XIV.,[1] containing the elements and some applications of his theory, and in 1854 he had published the complete theory and its applications to various engines, making instant use of the splendid experimental results just then obtained by Regnault. From this time it has been as possible definitely to forecast the result to be expected from any kind of engine as from 1690 to predict the behaviour of the moon.

From a philosophical point of view, there was a keen race in discovery between Thomson, Rankine, and Clausius, a race in which Thomson had the start, but which was neck and neck between Rankine and Clausius. But from the practical point of view Rankine was alone. And in this respect these papers, as indeed all his others, have a value both intrinsic and as examples of method which even transcends their philosophical value.

It was Rankine's practical knowledge which gave him his great advantage, but he had in some respects an advantage in having based his theory by means of an hypothesis on the fundamental laws of motion. Rankine worked from an hypothesis of his own creation as to the molecular constitution of matter, which was perfectly definite and capable of including all the phenomena which he had to consider. The definiteness of his hypotheses gave that definite form to his formula which suggested many points otherwise overlooked.

But as often happens, the definiteness of his hypotheses was also his source of weakness; he assumed the atoms of matter to be masses of fluid subject to eddies and vibrations, but otherwise at rest. This suited the conditions of his problem, but it was only an hypothesis, and as it was definite, so any phenomenon with which it was incompatible sufficed to disprove the hypothesis and bring down the edifice raised upon it. And such phenomena, those of diffusion, existed, although they did not come within the range of his work.

Rankine was himself fully alive to his position, and having once obtained his ideas and framed his formula, took and acknowledged a hint from his contemporaries, Thomson and Clausius; and having shown that Carnot's theorem, which they had modified and made the basis of their reasoning, was a consequence of his molecular vortices, he adopted a general law as the base of his reasoning, and cut himself off from his hypotheses. This was easy for him to do, for, as may be seen in § 15*a* of Paper III., he had with no small care framed his hypotheses so as to fit the same law, though expressed in other words. This article is also interesting as showing the unlimited faith he must have reposed in the design and care of Providence. Not only does he conceive each atom of matter to possess a fluid atmosphere, in which exist a number of similar cyclones or eddies, symmetrically placed all over the atom, but he required that wherever two atoms touched there two eddies should face, and so exactly as to be coaxial. Many complicated properties were attributed by Newton and others to the corpuscles of light, but such a demand as is here implied on the attention of Providence has probably never been equalled.

[1] Why this paper is placed so far out of its chronological order does not appear.

—a whole crew of Maxwell's demons on each atom would be required to warp and moor for every movement that might occur. But so true was Rankine's knowledge of mechanics that all this elaborate refinement did not prevent his hypothesis leading him to correct results.

This refined organisation, however, which renders his hypothesis in the highest degree improbable, suggests a most important consideration. For the almost infinite complexity of his particular arrangement indicates almost to the extent of a proof that the results he obtained must depend upon circumstances so general as to be independent of any particular hypothesis, so long as it is in conformity with the laws of motion, and hence the trail of these general circumstances is crossed.

In Rankine's hypothesis the temperature comes out as a direct measure in any particular substance of the kinetic or actual energy of the molecular motion This conclusion, to which he adhered in the final foundation of his theory, is general, but it does not appear to be the most general conclusion of which our present experiments admit It led Rankine to give a definite form as well as name to his thermodynamic function, which forms the fundamental equation of all the mathematical work But it was subsequently shown that the differential equation to the same lines could be obtained without the assumption with regard to temperature, and then it did not appear that there was sufficient experimental data for the complete determination of the constants which enter into the integral. This is owing to the hitherto impossibility of determining the exact form of the adiabatic curve for solids and liquids With gases it is different, and with these Rankine's law is found to fit, but so might a law framed on the supposition that in other cases the kinetic energy was some other function of the temperature. What is proved therefore is not that the temperature is a direct measure of the kinetic energy, but that this is some function of the temperature This is apparently all that has yet been accomplished, so that Rankine's definite conclusion must be looked upon as suggested rather than proved by experiment There can be no doubt however that this definiteness led to a vast development of the subject, and hence it was no mere fancy or partiality for his own view which led him to adhere to that form of second law which included his earlier view. Nor will the study of Rankine's earlier papers be time wasted on the part of those who seek to understand this extremely difficult subject They will there find a model of the machinery by which the general result might be obtained, and if, as is the case with most new inventions, the machinery is unnecessarily complex, it is still the only machine which has accomplished the results

They will also find, what must for ever add an interest to these papers, the first use of the terms thermodynamic function, adiabatic curve, potential energy, and others now in general use, for Rankine's nomenclature, to a great extent his notation, and entirely his graphic method, have been universally adopted

Rankine's methods have been called "uncouth," "diffuse and obscure," and without doubt they must seem all this to those who come to the subject with all the latest inventions in the form of mathematical machine tools in perfect working order,—just as the axe or adze must seem barbarous when there is a planing machine at hand to do the work, and the material has been prepared for it. But let the shape required be of a novel kind, or let the material be in the rough, and then how does it fare with the planing machine?

Like that of Green, the whole career of Rankine is one rebuke to those who would exhaust the finest material on this earth—the best brain of our youth—converting it into elaborate mechanism only adapted to reduce, in however elegant a manner, already prepared billets to elegant and improved copies of masterpieces which, having once been shaped, although roughly with primitive tools, can never have to be shaped again. The material at last existed for a great mathematical edifice, of which the want had long been felt, and our great mathematical workshop was crowded with the most refined mechanism rusting for want of material to work upon. But this material was in the rough, and while waiting for some one to strip off the bark the chance was lost, for the obscure, self-taught mechanic who set to work with axe and adze did not stop at the bark, but with rapid and well-directed strokes brought out the form divine. However uncouth Rankine's methods may be, they have the great merit that they require nothing but a bold front—the result being obtained without adventitious aid They are inscrutable to those who, having learnt the relations between quantities as expressed by symbols, have forgotten if they ever knew the purpose of their formulæ But to the reader who thinks Rankine's methods are a statement of his thoughts, and though often a rough task, any one who succeeds in understanding Rankine finds to his satisfaction that he has done more than this, that he understands what Rankine understood

Nor is this true only of his great work. What seems to us his most useful work is that of showing how the elementary mathematical methods were sufficiently adaptable to be applied to almost all cases of practical mechanics The results are only approximate, but where neither the data nor the desired result can be exactly measured, this is all that could be obtained, were the methods never so exact One might as well set bricks by Sir Joseph Whitworth's millionth-of-an-inch machine as use the exact equation of thermodynamics to determine the probable work to be obtained from a steam-engine.

The graphic method was Rankine's great weapon. This, which is probably as old as any mathematical method, had been long neglected, except that it was sometimes used for engineering purposes Rankine early perceived its applicability to the subjects he had to teach, and in his treatises on Applied Mechanics, Shipbuilding, and the Steam-Engine there are many instances of its novel and useful application which have been copied far and wide, while his graphic treatment of the subject of thermodynamics has been universally adopted. But the height of his achievement in the application and development of the graphic method is only reached in his papers on the motion of fluids.

These papers, with the omission already noticed, are collected at the end of the volume, and they constitute by no means its least valuable part. They are comparatively his later work. The first, "On the Exact Form of Waves at the Surface of Deep Water," was published in 1862, after his thermodynamical work was essentially complete.

Both the method and matter of this paper are unique The results are obtained by a simple geometrical study of rolling circles And there for the first time definite reasoning is adapted to the actual proportions of deep-sea waves, all previous work on the subject having been based on the assumption that the height of the wave is small compared with its length

It is however in the next paper that he first shows what may be done by Maxwell's method of the graphic use of families of surfaces or curves. Here we have what is invisible in the fluid itself and had only been expressed by complex algebraical formulæ—the internal motion of the fluid—shown in such a way that not only the direction but the magnitude of the motion at every point may be taken in at a glance as well as definitely measured, and all deduced by simple but rigorous geometrical methods The credit of this, which is certainly one of the highest achievements in the art of expression, must be divided. It was Faraday who first conceived the force of a magnet expressed by a family of lines, and it was Maxwell who discovered the rigorous method of drawing Faraday's lines, while Rankine realised in this the means of applying and expressing the principles of the steady flow of fluids propounded by Stokes now forty years ago

In these papers on Hydrodynamics, as in all his other work, Rankine had a practical purpose in view In this case it was the skin resistance and wave resistance of ships. And if, owing to the neglect of friction in the fundamental equations of motion, some of the results are still doubtful, yet in this respect the work is on a par with all the rest that has been done on this subject And these papers, owing to the clear conception they convey of the internal motions of fluid and the direct purpose of the means adopted to elucidate these, afford by far the best chance for any one wishing to pursue the subject up to the highest position it has at present attained

That Rankine himself owed much to having early directed his thoughts to fluid motion appears in all his work, as well as being shown by his theory of molecular vortices —a strictly hydrodynamical conception—amongst the intricacies of which nothing but his exact knowledge of the subject could have kept him straight

It must be remembered however by those who would make a like use of such knowledge that Rankine did not begin his career by the study of mathematics, but that as an engineer from his birth, as we are told in the Memoir, he first became aware of the circumstances and problems of mechanics, and only evolved or acquired his mathematics as he found them necessary to his work In this way his knowledge of mathematics must have included the knowledge of the necessity for each step It was necessity first, and then method or invention, and not, as is too often the case with those who begin to learn mathematics before they are aware of what it is they are to do, all means and no ends.

In Rankine's text-books, as in his original papers, the ends are always kept in view. It is often impossible for others to follow him unless they begin by actually mastering the circumstances of the problem and trying to solve it for themselves, then if they honestly fail they will find that Rankine will help them, while if they succeed they will find that Rankine was before them. These books, both as regards originality of matter and the attention paid to the circumstances of each problem, have more the character of original papers than orthodox text-books From this as well as his other writings it is clear that he acquired his knowledge of mathematics from the original works of the master, and not from text-books

His example should therefore be the best recommendation for all those who would really understand mechanics to read the works direct from the hand of this master—a task which, with the aid of this volume, they may now accomplish without that trouble of search which, small as it is, leaves many a masterpiece on the shelf in some dark corner, while a mutilated and garbled extract disgusts the reader and discredits the thinker

OSBORNE REYNOLDS

THE FERNS OF NORTH AMERICA

The Ferns of North America, Coloured Figures and Descriptions, with Synonymy and Geographical Distribution, of the Ferns of the United States of North America and British North American Possessions By D C Eaton, Professor of Botany in Yale College The Drawings by J H Emerton and C. E Faxon 2 Vols quarto, pp 352 and 285, 81 Plates. (Boston S E Cassino, 1880)

THIS handsome work, which has been brought out in parts, issued about one every two months, beginning with 1878, is now completed Although ferns have long been popular in the United States, both with collectors and cultivators, this is the first large illustrated monograph of the indigenous species which has been attempted For our own country we have several, of which the best known are Hooker's "British Ferns," with coloured figures, in large octavo, Lindley and Moore's "Nature Printed Ferns," in more than one edition; and Newman's "British Ferns," in which the plates are uncoloured woodcuts, but of the American ferns there are but few figures, and those widely scattered in general works, and even leaving figures out of the question there has been no descriptive handbook specially devoted to them, so that those who wanted to work at the subject have been placed at a great disadvantage. Prof Eaton, who is the grandson of a well-known botanical author, has been universally recognised for the last twenty years as the leading authority on the subject He has a large library and general collection of his own, has visited Europe and studied the American ferns in the public herbaria of the Old World, has proved himself in other departments of botany to be a careful and judicious systematist, and he is a teacher of botany of many years' experience, and has been looked up to for a long time by all the collectors of ferns throughout the Union as their referee in cases of doubt and difficulty, so that he has had every advantage for dealing with his subject in a thorough and exhaustive manner, and as he has been ably seconded by his two artists, the result is a monograph which is thoroughly satisfactory in every way, and which will be universally accepted both at home and in Europe as a standard work.

The geographical area which it covers is the whole of the American continent, from the Pole to the southern boundary of the United States The true ferns only are included, not the Lycopodiaceæ, Equisetaceæ, and Rhizocarps, which are monographed along with the ferns by

Hooker, Milde, and in the earlier editions of Newman In North America the order is represented by 139 species and 31 genera. The number of species is quite double what we have in the whole of Europe The northern area outside the United States produces very few species that have not been found within the bounds of the Union As in Europe there are no Cyatheaceæ, Marattiaceæ, nor Gleicheniaceæ Of the other sub-orders the Schizæaceæ, which we do not possess, are represented in the United States by three genera and four species. Ceratopteris, of which Prof. Eaton makes a special sub-order, is also American, but not European. The other four sub-orders—Polypodiaceæ, Hymenophyllaceæ, Osmundaceæ, and Ophioglossaceæ—are represented, both in America and Europe One peculiarity of ferns is that the genera show exceedingly little tendency to geographical localisation The nearest approach to this that we have in North America is the predominance of Pellæa, Cheilanthes, and Nothochlæna, which are allied dwarf types with a greater power of resisting drought than any other set of ferns, and which are represented in this area by a large proportionate number of endemic species These three genera take up thirty-nine species in North America against four for Europe. Out of the 139 species about forty are endemic, and about forty are European, the latter including several of our high mountain types, such as *Cystopteris montana*, *Aspidium Lonchitis*, *Polypodium alpestre*, *Woodsia ilvensis*, *glabella*, and *hyperborea*. The southern boundary of the States corresponds broadly with the limit in a northern direction of the great tropical flora of Equatorial America, the richest tropical flora in the world But out of the 139 ferns at least twenty are characteristically widely-spread tropical species which do not extend beyond Florida, which have several of them only been discovered there within the last few years Such are *Ophioglossum palmatum*, *Acrostichum aureum*, *Polypodium aureum*, *P Phyllitidis*, *P Plumula*, and *P pectinatum*, *Vittaria lineata*, and *Nephrolepis exaltata* Amongst the remaining species there are some curious cases of a *rôle* of distribution it is difficult to explain or understand *Adiantum pedatum* and *Osmunda cinnamomea* are examples in ferns of a considerable group of American plants which reach Asia by way of Japan and run down through China to the Eastern and Central Himalayas, *Pteris serrulata*, found lately in America in Alabama, and South Carolina, reappears only in China, *Pellæa andromedæfolia*, which from California passes down the Andes to Chili, reappears in Cape Colony *Nothochlæna tenera* is supposed to be divided between Southern Utah and the Andes of Bolivia and Chili, but here I think that the States plant will most likely have to rank as a distinct species. *Aspidium mohrioides*, long supposed to be endemic in extra-tropical South America, has been discovered lately by Mr Moseley in Marion Island, and by Mr Lemmon in one place at an elevation of 8000 feet above sea-level amongst the mountains of California

As regards the limitation of genera and species Prof. Eaton differs but little from Sir William Hooker, as the English author's views are expounded in his great monograph of the ferns of the whole world, his "Species Filicum" Prof Eaton treats Hymenophyllaceæ and Ceratopterideæ as distinct sub-orders, the former at any rate a decided improvement upon Sir W. Hooker's classification, and he maintains Ophioglossaceæ as a distinct order. In genera the principal deviations are that he keeps up Phegopteris as distinct from Polypodium, and merges Nephrodium in Aspidium.

A very curious North American fern is *Asplenium ebenoides* of Scott. It is very rare, and always grows in company with the walking leaf (*Camptosorus rhizophyllus*) and *Asplenium ebeneum*, two common American species These are very dissimilar plants, but *A ebenoides* is quite intermediate between them. Prof. Eaton seems not disinclined to the idea that it may be produced by natural hybridisation, as was suggested by the Rev M. J. Berkeley in the *Journal* of the Royal Horticultural Society for 1866, p. 87.

An observation of Prof Eaton's under *Nothochlæna Fendleri* is interesting as bearing upon Milde's classification of ferns into a catadromous and anadromous series, according as to whether their lowest secondary branches originate on the posterior or anterior side of the pinnæ Prof Eaton notes that in this species there is always a decided inequality in their origin; but that it is sometimes on the anadromous, and at others on the catadromous plan J G. BAKER

KOLLIKER ON ANIMAL DEVELOPMENT

Grundriss der Entwickelungsgeschichte des Menschen u der hoheren Thiere. Von Albert Kolliker, Professor der Anatomie an der Universitat Wurzburg. (Leipzig W Engelmann, 1880.)

THIS book is essentially a reproduction of Prof Kolliker's large treatise on Embryology, with a great part of the detail and controversial matter omitted, and is intended for the use of medical students The larger work has more the character of a monograph on the development of birds and mammals than of a text-book, and as such, though of very great value to those engaged in teaching and research, is necessarily too bulky for the use of ordinary students. We think, therefore, that Prof. Kolliker has done very wisely in publishing the work before us; and we need hardly say that, his larger treatise having been already universally recognised as one of the most important contributions to embryology during recent years, the present work may safely be regarded as an accurate statement of the facts of avian and mammalian embryology. We may add that no trouble has been spared in the illustrations, which fully come up to the high standard characteristic of German works of this class.

While, however, we can say this much in praise of Prof Kölliker's treatise, we cannot help recognising that it has some rather serious defects. Prof Kölliker is an extremely objective writer. He describes with great clearness the objects as they present themselves to the observer, but he scarcely ever attempts to connect them together or to point out the general principles which underlie the mass of detail with which he has to deal. In his larger work this peculiarity is of comparatively small importance, in that those who are likely to use it are able to supply the general principles for themselves; and the work has already become a great mine of facts to which every anatomist who is engaged in studying the morphology of vertebrates will necessarily turn.

In a book however intended for medical students, it is, in our opinion at least, of the utmost importance that the facts of embryology should not merely be stated in succession, but that their significance should be pointed out. Embryology is of but little practical value to a medical student, and the small amount he must necessarily know could be given in a very few pages, and is, we believe, usually to be found in works on human anatomy Considered however as an educational instrument, embryology is of the utmost value. It gives to the student an insight into the meaning of the structures which he meets with in his dissections, and by so doing often renders details of anatomical structure comparatively easy and pleasant of acquisition, which would otherwise be a great and almost repulsive strain on the memory.

Embryology should be taught to the medical student as a comparative science, with the facts duly marshalled, their significance pointed out, and general principles deduced from them In such a form it ought to constitute an important part of medical training, which every medical school of any pretence to excellence should impart to its students.

We would venture to call attention to the following instances as illustrative of what we consider the unsatisfactory treatment of certain parts of the subject to be found in Prof. Kölliker's work. In dealing with the phenomena of segmentation Prof. Kolliker makes no effort to point out that the differences in the early development of the mammal and bird are in the main the result of the presence of food yolk in the one case and its absence in the other After reading his very careful and elaborate treatment of the primitive streak, the student would, we think, be left in complete ignorance of the real significance of this interesting structure.

Again, in his account of the placenta, which he describes in man and the rabbit, he has so little to say as to any comparison between the two that we are at a complete loss to understand why he should have made any mention of the former.

In his account of the development of the vascular and excretory systems we are struck with the almost entire lack of any attempt to put the facts which have been so admirably described to their legitimate use, viz. to the explanation of the arrangement of these and other structures in the human body, and of the presence of rudimentary organs.

In making these strictures on Prof. Kolliker's work we should be sorry to convey the impression that we underestimate the value of this in most respects admirable treatise. It has already become justly popular in Germany, and we trust that it will also become widely known in this country

OUR BOOK SHELF

Bulletin of the United States Geological and Geographical Survey of the Territories, 1879-80. Vol. v. (Washington, 1880)

THE publications issued by the American Government under the above title are so appreciated in this country that it seems unnecessary to compliment Dr. Hayden and his coadjutors on the appearance of another of their useful volumes During the last few years, however, there have been brought out by the U.S. Department of the Interior some works by Dr. Elliot Coues, which for patient industry must compare with any that have ever been compiled in scientific literature The title of the volume now before us reads as follows --Art. 26 Third Instalment of American Ornithological Bibliography, by Dr Elliot Coues, U.S A, and consists of 545 octavo pages of small print How many titles of papers and books are quoted in this laborious treatise we should be sorry to have to count. The labour must have been enormous, and it is only those who have to follow the intricate windings of synonymic literature who can appreciate the work here performed by Dr Coues We learn that we may expect at some future time a similar conspectus of titles relating to the ornithology of the Old World, but although the present volume professedly deals with American Birds only, many standard works of general interest are passed in review by the author, who exhibits great judgment as a critic Taking Gray's "Hand-List of Birds" as a basis of classification to follow, Dr Coues treats of each family separately, and then in chronological order he records every work, every paper, and every note which directly or indirectly affects the American species, and as regards each year the publications are separately entered under the authors' names in alphabetical order We must however again warn ornithologists that so many collateral references are given to Old World papers where the families are at all cosmopolitan, that therefore no one writing on any group of birds can afford to neglect this book As for Dr Coues himself, we can only imagine the sigh of relief with which he must have corrected the last proof of such a toilsome undertaking, although he must have been assured beforehand of the heartfelt gratitude of every ornithological *confrère* throughout the globe. R B S

(i) *Exposition Géométrique des Propriétes générales des Courbes* Par Charles Ruchonnet (de Lausanne) Quatrième édition augmentée (Paris, 1880.)

(ii.) *Éléments de Calcul approximatif.* Par C Ruchonnet (de Lausanne) Troisième édition revue (Paris, 1880)

HAVING noticed both these works on the appearance of the last previous editions in 1874, we need say little here The reasoning In i, we may remark, is always upon the curve itself, and is not derived by taking the limiting form of the inscribed polygon, and similarly in the case of surfaces. The work has grown from 160 pp to 174 pp, and there is one more plate of figures

The pamphlet ii. is, what it is stated to be, a revised form of the last edition It consists of 64 pp in place of 65 pp

Geschichte der geographischen Entdeckungsreisen im Alterthum und Mittelalter. Von J Lowenberg (Leipzig und Berlin Otto Spamer, 1881.)

THIS is a volume in the publisher's Illustrated Library of Geography and Ethnology It is, as its title indicates, a History of Geographical Discovery in Antiquity and during the Middle Ages The story is brought down to the time of Magellan and Martin Behaim. The first book, under the heading of Night and Morning, treats of the earliest dawn of geographical knowledge with the Hebrews, Egyptians, Babylonians, Phœnicians, Greeks, and Romans; the second book embraces the period from Herodotus to Ptolemy; the third, the Middle Ages, and the fourth the Century of Discovery, in which Spain and Portugal did such splendid work Herr Lowenberg has evidently taken great pains to master his subject, and has been quite successful. He treats it in considerable detail, both in its historical and scientific aspects; the arrangement is excellent, and while popular and attractive in style, the work seems to us to be accurate and altogether trustworthy. There are numerous illustrations, some of them rather fanciful, but most of them useful and appropriate—portraits, ships of various periods, maps, some of them reproductions of very early ones, and

places and monuments illustrative of various countries Altogether the work is a really good specimen of its kind. Another volume will bring the story down to the present time.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

The Tide Predicter

I SEE in your last number (p. 467), among the editorial notes, the following —"Mr. Roberts of the *Nautical Almanac* office is authorised, by resolution of Council of the Secretary of State for India, dated August 7, 1880, to make it generally known that his Tide Predicter may be employed for the preparation of Tide Tables for any port for which the requisite data are forthcoming"

I think it right to call your attention to the fact that the Tide Predicter is in no sense of Mr Roberts's invention or design He was employed in 1873 by me, as chairman of the British Association Tidal Committee, to calculate the number of teeth in the wheels of the first Tide Predicter (now the property of the British Association, permanently deposited in South Kensington Museum), and to superintend its construction in London by Messrs A Légé and Co. The second Tide Predicter was made for the India Office, according to my advice, by Messrs A Légé and Co of London, under the superintendence of Mr Roberts. In respect to the plan of the wheelwork, which is wholly due to Messrs Légé, it is a copy of the first instrument. It is an improvement on the first instrument in having twenty tidal components instead of ten, and in having the well-known rigorous method of the slide (Thomson and Tait's "Natural Philosophy," § 55, or "Elements of Natural Philosophy," § 72) for producing simple harmonic motion in a straight line from circular motion, instead of the approximate method of pulleys centred on crank-pins, which for simplicity and economy I used in the first instrument WILLIAM THOMSON

The University, Glasgow, March 19

The Magnetic Storm of 1880, August

THE Astronomer-Royal has handed to me a copy of the photographic record of the variations of magnetic horizontal force as registered at Toronto during the disturbed period of August 11 to 14 last The records of declination and vertical force were imperfect and have not been received

The comparison of the Greenwich and Zi-ka-wei (China) curves for the same period (NATURE, vol xxiii. p 33) indicated that the commencement and end of disturbance (especially the commencement) occurred nearly simultaneously at both places, and this circumstance is now further corroborated by the Toronto horizontal force curve.

In what follows, the reference throughout is to Greenwich time.

The disturbance at Toronto commenced on August 11 at 10 20 a m. At Greenwich (NATURE, vol xxiii. p. 33) it commenced also at 10 20 a m , and at Zi ka wei at 10.16 a.m , at Melbourne (NATURE, vol. xxii p 558) it commenced at 10.33 a.m.

Disturbance ceases at Toronto at about midnight of August 11, and at Greenwich and Zi ka-wei also at about or near midnight, but it dies out more or less gradually, not allowing the limit of disturbance to be always very precisely fixed.

Sudden motion is again shown (after some hours of quiet) at Toronto on August 12 at 11 40 a.m., also at Greenwich at 11 40 a.m., some minutes sooner at Zi-ka-wei ; and at Melbourne at about 11.38 a m

Disturbance again dies out more or less gradually at Toronto on August 14 about 7 a m , at Greenwich and Zi-ka-wei at about 6 a.m., and at Melbourne at about 7 a.m.

The commencement of disturbance in the above instances is definite, and the agreement in time, considering the widely noteworthy The cessation of disturbance is less definite, as has been already remarked, but even here the discordance in time is not very wide WILLIAM ELLIS

Royal Observatory, Greenwich, March 12

Prehistoric Europe

I MUST adhere to my decision not to play the part of Secutor any further to a glacial Retiarius in the arena of NATURE If his net be strong enough to carry the Upper Pleiocene and the Pleistocene mammalia of Europe, as well as Palæolithic man and the Neolithic skull of Olmo, I wish him joy of them If, further, he will kindly give me the proof that the mammalia of Auvergne, considered Upper Pleiocene by Falconer, Gaudry, Gervais, and other leading palæontologists, are, as he terms them, "a hash up," they shall be properly served and *iced*, if necessary, in my second edition

I feel however that it is only right for me to notice the new gladiator who springs to the aid of his friend The antiquity of man in the Victoria Cave is solely due, as it appears to me, to the *perfervidum ingenium* (I speak in all respect) of Mr. Tiddeman It was first based on a fragment of fibula which ultimately turned out to belong to a bear. Then it was shifted to the cuts on two small bones, which were exhibited and discussed at the British Association, at the Anthropological Institute, and at the Geological Society of London The bones are recent, and belong to sheep or goat, two domestic animals introduced into Britain in the Neolithic age. The cuts have been probably made by a metallic edge Numerous bones of the same animals, in the same condition and hacked in the same way, occurred in the Romano-British refuse-heap on the top of the clay, and frequently slipped down over the working face to the bottom of the cutting before I resigned the charge of the exploration to Mr Tiddeman after nearly four years' work There were frequent slips afterwards. Under these circumstances the reader can decide whether it is more probable that the mutton-bones in question did slip down from a higher level to be picked out at the bottom, or that there is evidence of "interglacial" (J. Geikie) or "preglacial" (Tiddeman) man possessed of domestic animals and probably using edged tools of metal The mutton-bones seem to me to prove so much on the latter hypothesis, that they may be thrown aside without further thought

The reindeer (bones of feet) was found in 1872 along with fox, rhinoceros, elephant, hyæna, and bison in the cave at the lower horizon, which afterwards was proved to contain the hippopotamus It was omitted in Mr Tiddeman's lists up to 1876, when I called his attention to the fact Then he wrote that the fact that it was so found was "noteworthy," and that "these remarks [his generalisations] were made solely on the evidence which passed through your present reporter's hands since he undertook to conduct the exploration of the cavern" (Brit. Ass Rep., 1876, p. 118) Surely it is too late, in his letter to NATURE (March 10, 1881), to recall this on the grounds that these remains were discovered in a shaft, that my exploration was not carried on so accurately as his own, and further, that because he did not find the reindeer in the lower strata that I did not It is not for me to compare my own experience in cave-hunting with his, or to point out the value of negative evidence The exploration while under my charge was *not* carried on by shafts only. When the hyæna-layer was reached it was followed in the deep cutting visited by the British Association in 1873 The presence of reindeer in the hyæna layer renders Mr Tiddeman's views untenable which are based on its assumed absence. Most of these points have been so fully argued out before the above mentioned societies, that I am sorry to be obliged to repeat them in this letter. W BOYD DAWKINS

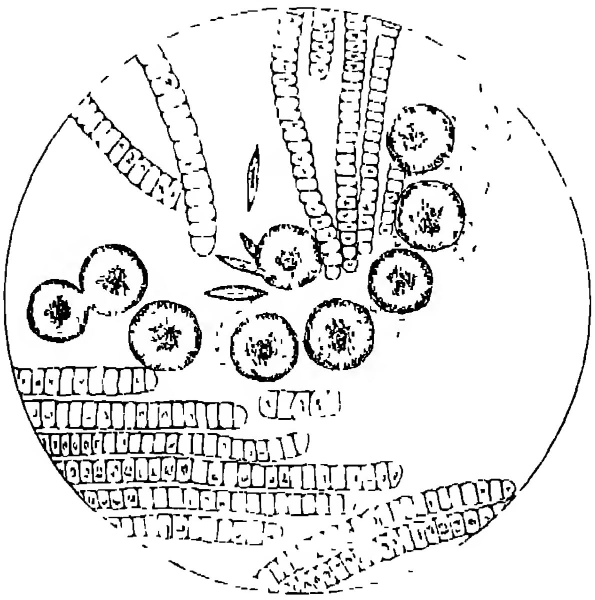
Owens College, March 11

Oceanic Phenomenon

H.M's surveying ship *Alert* was recently engaged in searching for a "shoal" which was reported as existing some 200 miles to the southward of Tongatabu, in the South Pacific In the course of the survey—which I may add tended to disprove the existence of any such shoal—it was observed that for several days the sea-surface exhibited large discoloured patches, due to the presence of a fluffy substance of a dull brown colour, and resembling in consistency the vegetable scum commonly seen on the stagnant water of ditches This matter floated on the surface in irregular

the sea-water to a depth of several feet. Samples for examination were obtained by "dipping" with a bucket, as well as by the tow-net. It seemed to be a Confervoid Alga

On slightly agitating the water in a glass jar, the fluffy masses broke up into minute particles, which, under a magnifying power of sixty diameters, were found to be composed of spindle-shaped bundles of filaments. Under a power of 500 diameters these filaments were seen to be straight or slightly curved rods, articulated but not branching, and divided by transverse septa into cylindrical cells, which contained irregularly-shaped masses of granular matter. These rods, which seemed to represent the adult plant, measured $\frac{1}{2000}$ inch in width. On carefully examining many samples, some filaments were detected, portions of which seemed to have undergone a sort of varicose enlargement, being more than twice as wide as the normal filaments These propagating filaments (if I am right in so calling them) were invested by a delicate tubular membrane, and contained some granular semi-transparent matter, in which was imbedded a row of discoid bodies, the latter appearing as if about to be discharged from the ruptured extremity of the tube. These bodies measured $\frac{1}{1000}$th of an inch in diameter · when seen edgewise presented a



lozenge-shaped appearance, and were devoid of cilia or striæ Conjugation was not observed.

On allowing a jarful of the sea-water to stand by for twenty-four hours it was found that the confervoid matter had all risen to the surface, forming a thick scum of a dull green colour, while the water had assumed a pale purple colour, resembling the tint exhibited in a weak solution of permanganate of potash.

From November 24 to 29, during which time the ship traversed slowly a distance of 330 miles, the sea contained these organisms. For the first three days the large patches were frequently in sight, and during the rest of the time the surrounding water presented a dusty appearance from the presence of the tiny spindle-shaped bundles On the evening of the 26th an unusually dense patch was sighted and mistaken for a reef, being reported as such by the look-out-man aloft.

Sydney, January 24 R. W. COPPINGER

Feeding a Gull with Corn

IN Prof. Semper's recently-published work on the "Conditions of Existence as they Affect Animal Life," a review of which from the pen of Prof Lankester appeared in your columns a fortnight ago (vol xxiii. p. 405), allusion is made on pp. 67, 68, and elsewhere to John Hunter's celebrated experiment of feeding a gull with corn Prof Semper, however, seems not to have been aware of the precise nature of the result of Hunter's experiment. He says: "The English anatomist Hunter purposely fed a sea-gull for a whole year on grain, and he thus succeeded in so completely hardening the inner coat of the bird's stomach, which is naturally soft and adapted to a fish diet, that in appearance and structure it precisely resembled the hard, horny skin of the gizzard of a pigeon."

The original account, I believe, of Hunter's experiment, was published in Sir Everard Home's "Lectures on Comparative Anatomy" (vol i p 271, 1814), and an extract from that work is appended to the description of Hunter's original preparation, still preserved in the College of Surgeons, in the descriptive catalogue of that collection (vol. v., 1833, pp. 149-50, Prep. 523). What Hunter succeeded in effecting was to very much increase the thickness of the *muscular* walls of the gizzard, which, as may be seen by comparing his specimen (No 523) with that of the stomach of another gull close by, have become developed to an extent about double their usual size. There is no manifest increase in the thickness of the "inner"—or so-called "epithelial"—coat of the stomach visible in the preparation, nor do Home or Owen allude to any such feature in their descriptions. Hunter's experiment, therefore, simply comes under the numerous well-ascertained instances of the increased development, consequent on increased use, of muscle, and has no real connection with the "modifying effects of food," such as that produced in canaries by feeding them on cayenne pepper, and others cited by Semper. W A FORBES

Zoological Society's Gardens, N W, March 18

Dynamics of "Radiant Matter"

As the chief object of Mr. Preston's paper under the above title in NATURE, vol. xxiii. p 461, seems to be to support Le Sage's "shelter theory" for gravity, you will perhaps let me point out one objection to that theory in any form which has hitherto been deemed conclusive, and with which Mr. Preston does not deal It is that under it gravity would not vary, as it is known to do, equally with mass, but would vary *not* equally.

The theory applies perhaps so long as you consider only the case of isolated atoms, but it fails entirely when applied to clusters of atoms.

Observation shows that gravity varies only with distance and with mass, but if it were caused by any form of shelter hitherto imagined, it would vary also with density and with bulk in such a way that a pound of, say water, would weigh more than a pound if raised into steam, because its atoms, in loose order as steam, would give each other less shelter from the action of the kinetic æther than when in close order as water, and in such a way also that two spheres of, say iron, each weighing one pound, would weigh less than two pounds if welded into one sphere, because some atoms in the one sphere would be better sheltered than any atoms in the two spheres WM. MUIR

March 21

The Oldest Fossil Insects

MR S H. SCUDDER has published (Anniversary *Memoirs* of the Boston Society of Natural History, 1880, pp. 41, plate 1) a memoir on the Devonian Insects of New Brunswick The fragments of the six described species were discovered by the late Prof C. F. Hartt in 1862, and have been since 1865 described in several papers by the same author. The new paper is a very detailed and elaborate one, with entirely new and improved figures, and is followed by a number of conclusions, as the final result of his work (Report, *Amer Journ. of Sci*, Feb 1881). The conclusions would be of prominent importance for the history of the evolution of insects, if they could be accepted without reserve Of course facts and conclusions should be able to stand the most severe test, and that is not the case with this publication. "As the simpler Devonian insects have certain special relations," he says, "with the Ephemeridæ, their description is preceded by an account of the wing-structure of the modern Mayflies as a basis of comparison" (p 4)

The simple fact that not one of the described species has any relationship to the Ephemeridæ is sufficient to cause us to object to his descriptions and conclusions related to this family. This statement is not based upon a difference of opinion, but simply on the evidence of facts which cannot be denied by any one conversant with the families Ephemeridæ and Odonata.

Platephemera antiqua is a part of the apical half of the wing, without the tip, of a gigantic dragonfly. The suddenly narrowed second cubital space is to be found in Isophlebia of the Solenhofen slate. The imperfectness of the fragment allows no further conclusions.

Gerephemera simplex is a diagonal fragment of the middle of

a wing of a gigantic dragonfly The reverse has a small part of the base, not to be seen in the obverse, with a straight sector crossing the horizontal ones. The same arrangement is to be seen in Isophlebia Every other character important for nearer determination is wanting in the fragment.

Lithentomum Hartii —The fragment is very insufficient, and recalls the venation of the Sialids, and among them those of the Chauliodes type.

Homothetus fossilis —This is a Sialid of the Corydalis type, with a small number of transversals The basal vein, spoken of as homologous with the arculus of the Odonata, and as proving a synthetic type, is the part in which the wing breaks off easily in actually living species I have not seen the type

Xenoneura antiquorum —Some details given for this species are not exact. It has not been observed that parts of one wing cover the other, I can only say that the wing belongs to the Neuroptera, and that the venation is nearer to the Chauliodes type than to any other The famous "stridulation" apparatus at the base is justly retracted by the author

Four new families are proposed for these insects by the author One of them, the Atoxina, is now out of the question, as Gerephemera belongs to the Odonata The three others are only indicated by extremely vague characters, in fact by no characters at all Can science accept such families? I believe not.

I omit *Dyscritus vetustus* because this fragment is undeterminable

My conclusions are, that two of the insects belong to the Odonata, three to the Sialids There is no Ephemerid among them, nor any synthetic species The proofs for my statements will be given in a detailed paper, H A HAGEN

Cambridge, Mass.

Ice-Casts of Tracks

As I was riding along the highway late this afternoon, my attention was attracted to a phenomenon no less curious than beautiful A couple of days ago there was a fall of a few inches of very damp snow, after which the temperature fell rapidly, and this morning everything was frozen hard. A large dog had trotted along in the snow while it was yet damp, and where it lay upon the old drifts by the road side. To-day the sun has been shining very warm, cutting away all the new snow and leaving the tracks of the dog in exquisitely perfect ice-casts, thin as writing-paper, and standing on the most delicate thread-like columns, about an inch above the surface of the old snow

Lyons, N Y., March 7 J. T BROWNELL

Migration of Birds

THE following extracts from a work entitled "Bible Customs in Bible Lands," by Henry J. Van Lennep, D D. (1875), may prove interesting to some of your readers, as containing important and reliable evidence with regard to the migration of birds, which has formed the subject of two recent letters in NATURE

Speaking of the great numbers of small birds which inhabit Western Asia, as compared with Europe and North America, Dr Van Lennep explains the circumstance by the fact that "even those of feeblest wing have an easy road from Palestine, Syria, and Mesopotamia, by the Isthmus of Suez, and over the narrow Red Sea, to their winter quarters in tropical Africa, while nature has provided them with *extraordinary means* of conveyance from Asia Minor southward across the Mediterranean . . . The swallow, and many other birds of similar powers of flight, are able to cross over the entire breadth of the Mediterranean, especially by taking advantage of a favourable wind But many birds are quite incapable of flying over a surface of 350 miles from headland to headland across the Mediterranean without alighting, and would require many days, and even weeks, to perform the trip through Syria and Palestine. Such are the ortolans, darnagas, bec-figs, wren, titmouse, smaller thrushes and finches, with a hundred other diminutive specimens of the feathered tribes . . . and as the severity of the winter would be fatal to them, not only in Asia Minor but even in Syria and Palestine, He who is ever mindful of the smallest of His creatures has provided them with means of transportation to a more genial clime Many of them, indeed, find their way downward from Palestine into Arabia and Egypt, but this would be difficult, if not impossible where lofty mountains and broad seas intervene, and to meet such cases *the crane has been provided* . . . Most of these birds are migratory In the autumn numerous flocks may be seen coming from the north with the first cold blasts from that quarter, flying low, and uttering a peculiar cry as if of alarm, as they circle over the cultivated plains. Little birds of every species may then be seen flying up to them, while the twittering songs of those already comfortably settled upon their backs may be distinctly heard On their return in the spring they fly high, apparently considering that their little passengers can easily find their way down to the earth."

As Dr Van Lennep has "spent almost a lifetime in the East," I conclude he has been an eye-witness of the above facts, and therefore his testimony is conclusive G. A.

Bath, March 16

Sound of the Aurora

WITH reference to the question mooted in last week's NATURE (p 459) by M L. Rouse as to the sounds emitted by auroræ, perhaps the accompanying extracts may be of interest.

Brighton, March 20 EDWD. ALLOWAY PAUKHURST

"*Record of a Girlhood*," *F. A. Kemble Vol. I.*

"Standing on that balcony [at Edinburgh] late one cold clear night, I saw for the first time the sky illuminated with the aurora borealis It was a magnificent display of the phenomenon, and I feel certain that my attention was first attracted to it by the crackling sound which appeared to accompany the motion of the pale flames as they streamed across the sky; indeed *crackling* is not the word that properly describes the sound I heard, which was precisely that made by the *flickering* of blazing fire, and as I have often since read and heard discussions upon the question whether the motion of the aurora is or is not accompanied by an audible sound, I can only say that on this occasion it was the sound that first induced me to observe the sheets of white light that were leaping up the sky. At this time I knew nothing of such phenomena or the debates among scientific men to which they had given rise, and can therefore trust the impression made on my senses."

I BEG to assure Mr. Rouse that about fifteen years ago, early in the evening, in this very quiet locality, I listened, along with my father, to the sound of an aurora, pulsing above us, across the zenith, and appearing nearer to us, or lower, than most auroras I had seen. The sound was somewhat like the rustling or switching of silk, and we listened to it for some time with great curiosity The aurora was not coloured, as more imposing ones have sometimes appeared, but white. It recalled to me the lines of Burns in a fragment entitled "A Vision"

"The cauld blue north was streaming forth
Her lights, wi' hissing eerie din,
Athort the lift they start and shift,
Like fortune's favours tint as won"

Dumfriesshire, March 20 J. SHAW

Tacitus on the Aurora

WITH reference to the passage of Tacitus, "Germ." 45, quoted in NATURE, vol xxiii p. 459, I would suggest that the reading *equorum*, proposed by some commentators, is far happier than *deorum*. "It is believed that a sound is heard, that the forms of the horses and rays from a head are seen" R. O. S.

Heidelberg, Germany

Aberration of Instinct

As an instance of "Aberration of Instinct," or I should rather say of *instinct at fault*, may be mentioned the following:—It is well known, I believe, that rooks in attacking young mangold-wurtzel pick out the plants to obtain the wireworm at their roots. It happens that plants most infested with these insects are the most flagged in the leaf. Now a neighbour whose sowing had been a partial failure transplanted some young wurtzels into the vacant places. These of course for a few days presented a flagged appearance, and were all seized on by the rooks to the exclusion of the rest Poor disappointed creatures, what must have been their chagrin at finding no wireworm as they evidently expected!

T. H. WALLER

Waldringfield Rectory, Woodbridge, March 16

Squirrels Crossing Water

A CORRESPONDENT in NATURE (vol. xxiii. p. 340) is surprised to learn of the squirrel taking to the water. It is not an un-

common thing for them to do so here, and they are frequently drowned in making attempts beyond their strength.

Some years ago I was rowing on Lake George in this State, when I observed one of these little animals in an open place, where from the course he was pursuing he must have swum nearly half a mile. He seemed almost exhausted, and when I held my oar towards him he readily accepted the invitation to come on board, ran up the oar, and then to my surprise ran up my arm and ascended to my shoulder! I do not know whether he simply followed his climbing instincts, or whether he sought an elevated point to get an observation However this may have been, after a short pause he descended and took his station in the bow of the boat, from which in a few minutes he plunged into the lake and struck out for land. He evidently miscalculated his remaining powers, for he was unequal to the effort, and soon gladly availed himself of a second opportunity of gaining a place of refuge He now sat quietly while I rowed him towards the land, evidently satisfied that he was in friendly hands, and that his wisest plan was to remain as a passenger. When close to the shore he made a flying-leap and scampered for the trees, doubtless grateful in his little heart for the kindness that had helped him over the critical part of his voyage

This was near the narrows of the lake, where it is about one mile in width, with groups of islands which shorten the traverses to less than a quarter of a mile. My little friend however had not availed himself of the easier and more circuitous route, but had boldly undertaken a directer course and a longer swim, which, but for the timely rescue, would very likely have been his last aquatic attempt FREDERICK HUBBARD

New York, March 10

IN connection with a recent letter in NATURE on the squirrel taking to water, the following facts may be of interest:—While camping for two summers recently in the wilderness of northern New York, I was much surprised at frequently seeing squirrels crossing the ponds and lakes of the region. We would sometimes find several of these strange navigators in the course of an afternoon's row They were seen most abundantly during the early part of July, indeed, later in the season, they were but rarely found During many summers of camping elsewhere I have never seen them take to the water It has occurred to me that the explanation of this peculiarity (if it be such) of the squirrels of this locality may be found in the nature of the region visited; for we find there a most intricate water-system, the whole region being dotted with ponds and lakes connected by small streams The necessity of taking to the water at times has perhaps enabled the squirrels to overcome their aversion to this element, and they have thus become semi-aquatic in their habits The squirrel to which reference is made is the common "red squirrel," *Sciurus Hendsonius* C.

Worcester, Mass, March 8

IN the autumn of 1878 I was salmon fishing in the River Spey, a few miles from its mouth, where the stream was broad, strong, and deep—when just beyond the end of my line I perceived a squirrel being carried down, but swimming higher out of the water than is usual with most animals. Its death by drowning seemed inevitable, as the opposite bank was a high, perpendicular cliff of Old Red Sandstone, where even a squirrel could hardly land. However it swam gallantly on, heading straight across the stream, and finally, after being swept down a long distance, emerged on the other side, where a burn intersected the rock, and fir-trees grew down to the water's edge. The left bank, where the squirrel must have entered the river, was low and shelving, and it selected a spot, accidentally or otherwise, whence the current carried it opposite to an easy landing-place on the right bank. CECIL DUNCOMBE

March 18

THE LATE MR. E. R. ALSTON

THE death of Edward Richard Alston, which took place at his rooms in Maddox Street on the 7th inst., leaves a vacancy in the thin ranks of the working naturalists of this country that will not be easily filled up. At the time of his death Mr. Alston was secretary to the Linnean Society, a member of the Council of the Zoological Society, and treasurer to the Zoological Club, and up to within a few days of his decease was engaged in active zoological work. Mr. Alston, who died of phthisis at the early age of thirty-five, although somewhat retiring in disposition, was of a particularly kind and amiable nature, always most friendly with those with whom he was brought into contact, and ready to help them by advice or assistance Mr Alston was of Scotch parentage, and a native of Ayrshire. Being from infancy of delicate constitution he was educated chiefly under private tuition, and did not go to school or college Notwithstanding these disadvantages he was a good scholar and a neat and concise writer, and had an excellent acquaintance with comparative anatomy Taking early to the pursuit of natural history he became a contributor to the *Zoologist* and other popular journals, principally upon mammals and birds Mr Alston's first important paper was an account (published in the *Ibis*) of his journey to Archangel, made in 1872, in company with his friend Mr. J Harvie Brown, in which excellent observations are given on the summer migrants and other feathered inhabitants of that previously little explored district Shortly afterwards Mr Alston moved his head-quarters to London during the first part of the year, and undertook the compilation of the portion of the *Zoological Record* relating to mammals, which he carried on in a very painstaking and methodical way for six years (1873-78) A new edition of Bell's British Mammals, which had long been called for, appeared in 1874 Mr Alston, although he is only credited with having "assisted" in this work, was, we believe, its virtual compiler From that date also he became a frequent reader of papers at the meetings of the Zoological Society and author of several excellent memoirs in the *Proceedings* Amongst these we may call special attention to his revision of the genera of Rodentia, published in 1876, as a most successful exposition of the many difficult points connected with the arrangement of this group of mammals, and to his memoirs on the Mammals of Asia Minor, collected by Mr C G. Danford (1877 and 1880). Mr Alston's last and most important work, which he had fortunately just brought to an end before his untimely death, was the "Mammals" of Salvin and Godman's "Biologia Centrali-Americana"—a great work on the fauna and flora of Mexico and Central America. The first part of this was published in 1879, the eighth number containing the completion of the Mammals in December last The death of this promising naturalist, when in the full tide of work, must be a subject of universal regret among all lovers of science

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RECENT MATHEMATICO-LOGICAL MEMOIRS

THE Boolian reform of logical science is at las beginning to manifest itself and to bear the first-fruits of controversy. Thirty years ago Boole's remarkable memoirs were treated as striking but almost incomprehensible enigmas Even De Morgan did not know exactly how to regard them, and in his "Syllabus of a Proposed System of Logic" (p. 72) thus allows their mysterious truth —"In these works the author has made it manifest that the symbolic language of algebra, framed wholly on notions of number and quantity, is adequate, by what is certainly not an accident, to the representation of all the laws of thought" But time and the efforts of several investigators have cleared up much of the mystery in which Boole wrapped his logical discoveries. The controversies now going on touch rather the precise form to be given to the calculus of logic, than the former question of the new logic against the old orthodox Aristotelian doctrine.

The most elaborate recent contributions to mathematico-logical science, at least in the English language, are the memoirs of Prof C S. Peirce, the distinguished mathematician, now of the Johns Hopkins University, Baltimore. Not to speak of his discussions of logical ques-

tions in the *Proceedings* of the American Academy of Arts and Sciences (vol. vii. pp. 250-298, 402-412, 416-432), we have from him the wonderful investigation contained in his "Description of a Notation for the Logic of Relatives, resulting from an Amplification of the Conceptions of Boole's Calculus of Logic" (*Memoirs* of the American Academy, vol ix. Cambridge, U.S , 1870, 4to) The contents of this remarkable treatise, which fills sixty-two quarto pages, demand the most careful study, but it would be quite impossible in this article to enter upon such study Prof Peirce has however quite recently interpreted his own views in a new memoir "On the Algebra of Logic," of which the first part, completed by the author in April last, was printed in the *American Journal of Mathematics*, vol. iii , and issued in September (4to, 57 pp.). After noticing the beautiful typography in which the *American Journal* rejoices, we find in this memoir a very careful inquiry as to what is really the form and nature of logical inference.

Prof Peirce treats in succession of the Derivation of Logic, of Syllogism and Dialogism (a new name for a form of argument), of Forms of Propositions, the Algebra of the Copula, the Internal Multiplication and the Addition of Logic, the Resolution of Problems in Non-relative Logic, with a further chapter on the Logic of Relatives The fundamental point, however, which is under discussion in the first two chapters touches the nature of the copula. There is abundance of evidence to show that given a few elementary forms, it is possible to spin out logical or mathematical formulæ simply without limit But the superstructure rests entirely upon the basis of elementary truth contained in the first axioms In logical science it is emphatically true that "C'est le premier pas qui coûte." There is a momentous choice to be made at the outset, and if we then take a wrong view of the nature of the logical copula, we can never come right again by any amount of development or formulisation.

Prof Peirce after mentioning that four different algebraic methods of solving problems in the logic of non-relative terms have been proposed by recent English and German logicians, adopts a fifth, which he thinks is perhaps simpler and certainly more natural than any of the others. Peirce commences by expressing all the premises by means of the copulas $-\!\!<$ and $\overline{-\!\!<}$, "remembering that $A = B$ is the same as $A -\!\!< B$ and $B -\!\!< A$" (p 37) These new symbols are to be interpreted so that $A -\!\!< B$ means (A implies B), in the way that water implies liquidity, or all water is liquid The symbol $\overline{-\!\!<}$ is the negative of the above, so that $C \overline{-\!\!<} D$ means that C does not imply D He then lays down five other processes which give the elementary theorems of the calculus, showing how to develop, simplify, transpose, and infer equivalency by these symbols. As however these processes occupy two quarto pages in their first statement, it is evident that they cannot be reproduced here The question which really emerges is not as to the power and originality shown by Prof Peirce, about which no reader of his memoirs can entertain the slightest doubt, but as to the wisdom of the first step, the selection of the relation expressed by the symbol $-\!\!<$ instead of that expressed by the familiar sign of equality $=$ Prof. Peirce begins by remarking that $A = B$ is the same as $A -\!\!< B$ with $B -\!\!< A$. For instance, all equilateral triangles are equiangular, and all equiangular triangles are equilateral But though these two assertions are equivalent to "equilateral triangle = equiangular triangle," Prof. Peirce elects to treat the two parts of the apparently compound proposition separately, his reasons being given partially on p. 21. This is not the first time that the same choice has been made, for, not to speak of Aristotle and the Aristotelians generally, De Morgan elected to base his systems of logic upon inclusion and exclusion, instead of upon equality. In his symbols X || Y is compounded of X)) Y and X ((Y (Syllabus, p. 24), that is to say all Xs are all Ys is made of all Xs are Ys and all Ys are Xs. Now without going far afield, I believe that a sufficient reason may be given for holding that both De Morgan and Peirce have chosen wrongly A class is made up of individuals, and the very conception of a class thus implies the relation of identity expressed in $A = B$. If I say the colour of glacier ice is identical with the colour of pure rain water, it is impossible to break this assertion up into "The colours of glacier ice are among those of pure rain water," and "The colours of pure rain water are, &c " The colour is one indivisible and identical Now if there is at the basis of all reasoning an elementary assertion of the form $A = B$, which is incapable of resolution into anything simpler, this sufficiently proves that Peirce's $A -\!\!< B$, or De Morgan's A)) B cannot be the original elementary form of assertion. Moreover, when we say that all equiangular triangles = all equilateral triangles, the real basis of assertion is that each possible equiangular triangle is identical with one possible equilateral triangle The plural is made up of the singular, and the singular is incapable of logical decomposition You may decompose $A = B$ into As are Bs, and Bs are As, but ultimate decomposition gives us $A' = B'$, $A'' = B''$, $A''' = B'''$, A', A'', &c , being individuals.

It is highly curious, however, that this very question arises again with reference to the so-called Calculus of Equivalent Statements recently published by Mr. Hugh MacColl, B A , in the *Proceedings* of the London Mathematical Society (First paper, November 1877, vol. ix. pp. 9-20, Second paper, June 13, 1878, vol. ix pp. 177-186; Third paper, vol x. pp. 16-28 ; Fourth paper, vol xi ; see also *Mind*, January 1880, pp. 45-60, and the *Philosophical Magazine* for September 1880).

There can be no doubt that Mr. MacColl has shown much skill in devising neat symbolic forms, and much power in using them Comparing his processes with those of De Morgan, for instance, it is impossible not to admire their symmetry and lucidity But when we touch the real point, the nature of assertion and inference, I am obliged to hold that Mr. MacColl has, like De Morgan and Peirce, elected wrongly What De Morgan expressed by X)) Y, and Peirce by $X -\!\!< Y$, MacColl puts in the form $x : y$, calling the assertion an *implication*. Curiously enough, he professes never to treat of things, but only of assertions, so that with him $x : y$ means that the assertion x implies the assertion y, or whenever x is true, y is true Having carefully considered Mr MacColl's proposals, I felt obliged to write of them in a recent publication as follows.—"It is difficult to believe that there is any advantage in these innovations, certainly, in preferring implications to equations, Mr. MacColl ignores the necessity of the equation for the application of the Principle of Substitution. His proposals seem to me to tend towards throwing Formal Logic back into its Ante-Boolian confusion."

In a paper printed in the *Philosophical Magazine* for January 1881, Mr. MacColl takes me to task and invites me to make good the charge about Ante-Boolian confusion, by entering into a friendly contest in the problem columns of the *Educational Times*. Having just recently spent the better part of fifteen months in solving other people's problems, and in inventing some two or three hundred new ones, published in "Studies in Deductive Logic," I certainly do not feel bound to sacrifice my peace of mind for the next few years by engaging to solve any problems which the ingenuity and leisure of Mr. MacColl or his friends may enable them to devise. I therefore decline his proposal with thanks. But I can easily explain what I mean by ante-Boolian, or what comes to much the same thing, anti-Boolian confusion. The great reform effected by Boole was that of making the equation the corner-stone of logic, as it had always been that of mathematical science. Not only did this

yield true and simple results within the sphere of logic, but it disclosed wonderful analogy between logical and mathematical forms, to which De Morgan adverts in the passage quoted above All true progress in the philosophy of those fundamental sciences depends upon ever keeping in view the fundamental identity of the reasoning processes, as depending on the process of substitution, practised explicitly by algebraists for some two or three centuries past, and implied in the geometrical reasoning of Euclid

But Mr MacColl takes a backward step, he says he can make a simpler notation by taking $\alpha : \beta$ instead of my $\alpha = \alpha\beta$ In regard to form there is absolutely no novelty in the implication, for it is simply De Morgan's X)) Y, or the ancient Aristotelian proposition A is B It is true that Mr MacColl makes his terms consist of assertions, so that all his assertions would appear to be assertions about assertions—a needless complexity, landing us in the absurdity that a calculus of equivalent statements has no means of exhibiting the statements themselves Mr MacColl claims indeed considerable advantage for his notation on the ground that in the syllogism $(\alpha : \beta)$ $(\beta : \gamma)$ $(\alpha : \gamma)$, the very same relation which connects α with β, and β with γ, connects also the combined premises $(\alpha : \beta)$ $(\beta : \gamma)$ with the conclusion $\alpha : \gamma$ He thinks that my notation is very clumsy and roundabout, because, as my propositions treat of things or qualities, I should have to use words to express the inference of one proposition from others In that case Mr MacColl must bring the like charge of clumsiness against the whole body of mathematicians, because their equations are between things or their magnitudes, and they still use language "hence," "therefore," &c, to express the fact that certain equations lead to other equations If there is any mathematical sign to denote inference, it is rarely used, unless it be the familiar $\therefore$ and $\because$, which are merely shorthand signs.

Mr MacColl however, while pointing out the excellence of his implications, objects to my statement that he rejects equations in favour of implications on the ground that his method admits of both forms "As a matter of fact," he says, "I employ both, sometimes even in the same problem. In my first paper . . I adopt the equational form throughout, in my second and third papers, which relate entirely to questions of pure logic, I generally adopt the implicational form, as the simplest and most effective; while in my fourth paper, which treats of probability, I mainly adopt the equational form" There is nothing which I can see in this to contradict my objection that Mr MacColl rejects equations *in favour of* implications Mr MacColl uses implications as "the simplest and most effective," but he adopts the equational form, I suppose, when he finds it indispensable, if not, why does he not hold to his simple and effective implication? If he finds one form best in logic and the other in mathematics, then he is ante-Boolian, because it was the whole point of Boole's labours to establish identity of method in logic and mathematics. I have really no wish to condemn Mr. MacColl's calculus or to enter into controversy with him, but in the interests of truth and sound science I must assert my belief that his implication $\alpha : \beta$ is at the best but a shorthand rendering of $\alpha = \alpha\beta$, which is Boole's form adopted by me I have not said, and do not undertake to say, that Mr MacColl's formulæ are not concise and neat. But a shorthand notation is bad if it obscures the real nature of the reasoning operation, and the fact that Mr MacColl always keeps the equation in the background as a reserve method to call into operation when needed, shows to my mind that his methods are mistaken in a philosophical point of view The very name of his method is "The Calculus of Equivalent Statements," and the word equivalent sufficiently implies that the equation is at the bottom of the matter The end of it all then is that $\alpha : \beta$ has one letter less in it than $\alpha = \alpha\beta$, and to save the trouble of writing this one little letter Mr MacColl would have us obscure all the grand and fertile analogies which Boole disclosed to the astonishment of mathematicians in 1847 and 1854 Mr MacColl says "The question whether the implication $\alpha : \beta$ or its equivalent the equation $\alpha = \alpha\beta$ should be preferred in a symbolical system of logic, must be decided on the broad grounds of practical convenience" It is not however a question of practical convenience, but of philosophical truth which is at issue, and in thus playing fast and loose with the equation, Mr MacColl shows his entire want of comprehension of what is involved in the Boolian reform of logic It may be added that were Mr MacColl to discard implications and use only the equations which he admits are equivalent to them, there would be no formal difference between his calculus and that modified form of Boole's calculus which I proposed in 1864, and have been ever since engaged in developing, excepting indeed Mr MacColl's unaccountable adoption of assertions as terms

Perhaps it ought to be added that Boole, both in his "Mathematical Analysis of Logic," and in his great "Laws of Thought," introduces chapters on what he calls "Secondary Propositions" or Hypotheticals, which deal, like Mr MacColl's assertions, with the truth of other assertions, but nothing emerges from Boole's discussion of secondary propositions except that they obey exactly the same formal laws as primary propositions, and are of course expressed equationally

W STANLEY JEVONS

ILLUSTRATIONS OF NEW OR RARE ANIMALS IN THE ZOOLOGICAL SOCIETY'S LIVING COLLECTION[1]

III.

THE animals we now speak of are again inhabitants of North-Eastern Asia—a country which, as before remarked, has of late years produced a considerable number of accessions to the list of Mammals Both of them also belong to the great group of Ruminants—which is of special interest, as embracing all the animals upon the flesh of which civilised man principally subsists

6 The Japanese Goat-Antelope (*Capricornis crispa*). For many years Siebold's "Fauna Japonica" was almost our only authority on Japanese zoology The Dutch, having long had a monopoly of Japan, were enabled to stock their great National Museum at Leyden with a host of objects unknown to the other cabinets of Europe, but of which their travellers and residents managed to obtain specimens from various parts of the land where they only were permitted to penetrate The "Fauna Japonica," although Japan is now open to all the world, still remains the best work of reference on the mammals of Japan. In it will be found the first description of the singular goat-like antelope of which the Zoological Society have recently obtained their first living example, drawn up by the celebrated naturalist Temminck, formerly director of the Leyden Museum Temminck named the animal *Antelope crispa*, from the rough coat of hair which covers it, and tells us that it inhabits the higher alps of the Japanese Islands Nippon and Sikok, and is known to the Japanese as the "Nik" But a more complete account of its habits has lately been published by Capt. H. C St. John in his recently-issued "Notes and Sketches from the Wild Coasts of Nipon" Capt St John tell us that the Japanese chamois, as he calls it, "is a very difficult animal to find, and to bag when found, they keep to the highest mountains, and to the highest and must rugged peaks of these ranges I have hunted them with the natives, and with their dogs, and this often, and yet only once, although often close to the creatures, have I had a

[1] Continued from p 417

glimpse of one, much less a shot. On one occasion I was lucky enough to see one, and this was by mere accident, and when not in search of game I have often been told fabulous stories about the Nigou, the native name for this wary animal. They were supposed to have one horn, and to use this single frontal ornament as a means of hanging on to trees as well as in self-defence After some years of anticipation and endeavour to get even a dead specimen, I got a couple, and then, strange to say, several others were brought to me. A young male, alive, was caught, after its mother was shot Only one specimen of all that were brought to me by the native hunters had both their horns intact—always one, and often both, being more or less broken In hunting them with dogs, it soon became evident why this was so generally the case. The Japanese, who knew the animal's habits intimately, invariably placed me near some huge bare slab of rock, on which the Nigou, when pressed by the dogs, was expected to appear, and on looking at these slippery sloping platforms, I tried to conjecture—when waiting for the animal to appear—where, if I knocked one over, it would tumble, and what shape or form it would be in by the time it stopped. I could then easily understand why the horns were usually so damaged

Fig. 6—The Japanese Goat-Antelope.

"I have no doubt also they are often caught in the bushes or trees by the slightly turned-back horns, on their falling and reaching the foot of these rocks, hence the origin of the story of their holding on to the trees.

"The young one which was brought to me alive was the most fierce little thing I ever saw. Any dog, large or small, that approached its cage, down went its head, and with a quick sudden spring the creature invariably came bang up against the wooden bars. Its horns were about two inches long, as sharp as needles, and quite capable of inflicting a very nasty wound

"The colour of the 'Nigou' is a brownish slate; the older they get the lighter-coloured they become. Until I actually had one in my hands, I was unable to decide whether they had a beard or not, and was pleased to find they do not possess this ornament—therefore they are true antelopes, and not goats."

For their unique specimens of this scarce animal the Zoological Society are greatly indebted to the energetic co-operation of one of their Corresponding Members, Mr. H. Pryer of Yokohama, Japan, by whom it was transmitted as a present to the Collection in April, 1879 The animal was then quite young, but has now attained full stature, and presents a very singular and characteristic appearance—quite different from that of either goats or antelopes—which is well shown in Mr. Smidt's drawing (Fig. 6).

The goat-like or mountain antelopes, to which the presents animal belongs, constitute a small group of the family Bovidæ, which is distributed over the mountain chains of Eastern Asia and its islands. The nearest geographical neighbours of the Japanese animal are *Capricornus Swinhoii* of Formosa, and *C. caudata* of China. In the Himalayas the genus is represented by *C bubalina*—the Thaar or Tahir of Indian sportsmen, and in the higher ranges of Sumatra by *C Sumatrensis*. In the Rocky Mountains of North America is found a far-separated member of the same group, which is known as the "Mountain Goat" by the American hunters (*Antilocapra Americana*) Our European Chamois (*Rupicapra tragus*) is not very distantly related to these animals

7 Luhdorf's Deer (*Cervus Luehdorfi*).—The existence in North-Eastern Asia of a large deer of the same form as the North American "Wapiti" has long been known, although the animal has never been very clearly identified. By some authors it seems to have been referred to the Red-deer (*Cervus elephas*), by others to the Persian Deer (*C Maral*), whilst the horns upon which the name *Cervus eustephanus* was founded by Blanford (in the Zoological Society's *Proceedings* for 1875) appear to belong to the same species. It is only quite recently however that examples of this fine animal have reached Europe alive, and its form and characters have become better known. In the autumn of 1876 two pairs of this deer were sent by Herr Luhdorf, the German Consul at Nicolajefsk, on the Pacific coast of Siberia, as a present to the Zoological Garden of Hamburg. They had been brought down the river Amoor from the far interior, having been obtained from some Nomads in the Bureati Steppe of Northern Mantschuria. The strangers throve well in their new quarters at Hamburg under the care of Director Bolau, and propagated their species. Several male fawns having been produced, one of them was parted with in exchange to our Zoological Society in London, and received in the Regent's Park in May last. From the specimen thus obtained, which is at present unique in this country, the accompanying illustration has been prepared.

It will be at once evident to those who are acquainted

with the various forms of true deer, that the new stag from Amoorland is exceedingly like the Wapiti. The resemblance indeed of the two animals is so close that except for the character of the horns it would be exceedingly difficult to distinguish them. But so far as can be ascertained from an examination of the present specimens, which is now believed to be nearly four years old, and from the particulars given of other horns by Dr Bolau in his description of the present animal,[1] Luhdorf's deer, as regards the character of its antlers, more nearly resembles our red deer than its American ally.

The discovery of a deer so closely allied to the Wapiti in Eastern Asia is a fact of special interest in geographical distribution. Taken in connection with other similar phenomena which have lately come to light, it tends to show very evidently that Northern America owes its many resemblances to the Palæarctic fauna, not to any former land connection between Europe and North America, as was formerly supposed by the advocates of the fabulous "Atlantis," but to a bygone extension of land between Eastern Asia and Western America. By some such passage there can be little doubt that the ancestors of the Wapiti, the American Bears, the Mountain Goat, and the Rocky Mountain Sheep found their way into the New World, to the more original fauna of which they have no sort of relationship.

FIG. 7.—The Luhdorf's Deer

METEOROLOGY IN MEXICO[2]

THE intertropical position of Mexico, on a high plateau between two continents and two vast oceans, renders the investigation of its meteorology peculiarly interesting. It is now more than four years since this problem was begun to be worked out with no little ability by the Mexican meteorologists, and, when the resources of the country are taken into account, with a spirit and liberality deserving of every commendation. This praise will not appear overstrained when we say that we have now before us for the city of Mexico a statement of the pressure, temperature, humidity, clouds, rainfall, direction and velocity of the wind, ozone, and other miscellaneous phenomena for every hour of the night as well as of the day, from March 6, 1877, down to October 16, 1880; and on the same sheet, in addition to the above, a daily statement of the chief meteorological elements for some thirty stations situated in various parts of Mexico, and at heights varying from 7 to 8189 feet above the sea. Annual *résumés* are also before us, that for 1879 having been received some time since.

During 1879 the mean atmospheric pressure at Tlacotalpam, situated near the sea and only 11 feet above it, was 29.938 inches, rising to the maximum, 30.075 inches in January, and falling to the minimum 29.851 inches in August. This seasonal distribution of the pressure holds good till the more elevated stations are reached, when pressure remains pretty constant during the year. This peculiarity becomes strongly marked at Zacatecas, the highest station, 8189 feet above the sea, where the January and July pressures are the same, and the lowest mean, that of March and August, falls only 0.016 inch below the annual mean, and the highest, that of November, rises only 0.024 inch above it. At all the stations the singular protrusion of a high pressure into the Atlantic and adjoining regions in the height of summer is represented in the means.

Of the greatest possible interest are the curves of the diurnal oscillations of the barometer, deduced from the hourly observations at the central station at Mexico, these curves being quite distinct, so far as we are aware, from the curves of any other intertropical place for which observations exist. The peculiarity lies in this, that while the morning maximum and the afternoon minimum remain large at all seasons, the morning minimum diminishes in amount as the summer advances; and during the strictly summer months it does not even fall so low as the daily mean. Now this is an outstanding peculiarity of the curves of diurnal pressure in the extratropical inland region of the great Europeo-Asiatic continent, and it becomes the more pronounced the more we advance into the interior of that continent. This result, viewed in connection with the other diurnal curves, forms a very valuable contribution to this difficult branch of the science.

The mean temperature for 1879 at Mexico, 7434 feet high, was 59°.5, May being the warmest month, 64°.6, and December and January the coldest, 55°.4, and these were generally the months of extreme temperature over the

[1] *Abh. d. Nat. Vereins zu Hamburg*, 1880, p. 33.

[2] "Datos Meteorologicos. Resumen de las Observaciones practicadas en varios Lugares de la Republica durante el Año de 1879." (Por el Ingeniero Civil V. Reyes. (Mexico, 1880.) "Boletin del Ministerio de Fomento de la República Mexicana." Tom. II., III., IV. V.

different districts of Mexico. The period of the year when temperature is highest is also the period when the air is driest, the mean relative humidity of Mexico for April and May for 1878 and 1879 being only 42 The mean temperature of Tlacotalpam, the lowest station, was 77° 5, and of Zacatecas, the highest from which mean temperatures are published, 61° 7 The difference of the two is thus 15° 8, and as the difference of height is 8178 feet, the fall of temperature with the height is comparatively slow, being only one degree for each 518 feet.

At Mexico during 1879, out of the 8760 observations made of the wind, 4156 cases were reported as calm, being nearly a half of the whole of the observations. By far the most frequent wind is the north-west, which was observed 1299 times; next follow the north-east, 789 times, and north 636 times, and the least frequent, south, 174 times, and south-west 278 times. As regards direction, the prevailing winds at Mexico were a point to the north of east in February and March, from which they gradually worked round to north-east in the beginning of May, north in July, north-west in September, thence again to north in the end of November, and back to east in February On these changes of the wind, considered with reference to the Gulf of Mexico and the Pacific, largely depends the rainfall The rainy season extends from about the middle of May to the end of October; but at eastern stations showers are of not infrequent occurrence from November to April, when prevailing winds are northerly and easterly. The largest annual rainfall was 89 16 inches at Tlacotalpam, and the least 15·66 inches at San Luis Potosí Thunder and lightning are of common occurrence during the summer months, these phenomena occurring on 66 per cent of the days during June, July, and August During the five months from December to April thunderstorms occur only on 7 per cent of the days. The position of Mexico, as already stated, marks it out as a region peculiarly suited for the investigation of some of the more interesting meteorological problems, particularly those which concern the vertical distribution of the phenomena, in connection with which an increase to the number of low-level stations on the Gulf of Mexico and the Pacific sea-boards is very desirable

ON THE IDENTITY OF SOME ANCIENT DIAMOND MINES IN INDIA, ESPECIALLY THOSE MENTIONED BY TAVERNIER

HAVING recently endeavoured to correlate the diamond deposits of India, I have been surprised to find what a mass of contradiction exists in both Indian and English literature as to the identity of some of the most famous mines which were worked little more than 200 years ago

In this brief account I propose to give results, not the steps which have led me to them Tavernier about the middle of the seventeenth century visited and described three diamond-mines, which were named respectively Raolconda in the Carnatic, Gani, called Coulour by the Persians, and Soumelpour on the Gonel River.

Raolconda, Tavernier says, was five days distant from Golconda and eight or nine from Bijapur, and most writers with signal unsuccess have tried to fix it accordingly But elsewhere Tavernier gives nine stages, aggregating probably 189 miles, on the road from Golconda to Raolconda, so that in the first statement the distances were probably transposed With these new indications we are led to an old town called Rawdukonda, lat. 15° 41′, long 76° 50′ I have not yet succeeded in obtaining any independent testimony of the existence of diamond-mines at this locality, but hope to be able to hear more about it ere long.

Gani, or Coulour, where Tavernier says the Great Mogul diamond was found in the sixteenth century, has been variously located by authors, being supposed by many to be identical with Gani Purtial, on the Kistua River, but I am satisfied from the evidence afforded by old maps that it is to be identified with Kollur, lat. 16° 42′ 30″, long. 80° 5′, which is also on the Kistna, about twenty-six miles further to the west. Now as to this word Gani, which has been treated of as a proper name, its recurrence in connection with two different localities suggests that it means mine In fact since G and K are interchangeable letters in some Indian languages we should probably read for Gani *Kan-i*, or the mine of Purtial or of Kollur

If, as seems most probable, the Koh-i-nur is identical with the Great Mogul diamond described by Tavernier, and that the great age claimed for it by the Hindus is to be regarded as mythical, then in fact for the first time the identity of the source from whence this famous diamond was obtained may be regarded as settled. Maps of the eighteenth century indicate diamond mines at Gani (*i e* Kan-i) Kollur, though local memory of their former existence appears to have died out

Soumelpour, on the Gonel River of Tavernier, has generally by recent authors been identified with Sambalpur, on the Mahanadi, in the Central Provinces. But Tavernier's somewhat precise indication of its position has led me to the conclusion that it was situated much further to the north, namely, in the valley of the Koel River, a tributary of the Sone At about the distance stated by Tavernier (which I calculate to be the equivalent of eighty miles), to the south of the well-known fortress of Rhotas, there are near the banks of the Koel River (*i e* Tavernier's Gonel) the remains of an ancient town called Semah, which word is identical with *Semul* (the native name of a species of cotton-tree, *Bombax Malabaricum*), Semulpour, or the town of the *Semul*, is therefore, it seems probable, Tavernier's Soumelpour The position of Semah is lat 23° 45′, long. 84° 21′, it is included in the sub-division of Palamow, in the Chutia Nagpur Province There is independent evidence of important diamond mines having existed in a neighbouring part of Chutia Nagpur in the sixteenth century, but there have been none in operation there for many years.

The last locality is Beeragurh, which is mentioned in the *Ain-i-Akbari*, and also in several other native writings This is unquestionably identical with the modern Wairagarh in the Chanda district of the Central Provinces, where excavations locally known to have been diamond mines are still to be seen Wairagarh is in lat 20° 26′, long 80° 10′. Many allusions which I believe to refer to this locality might be quoted. One of the fifteenth century by Nicolo Conti is of especia interest He says that at Albenigaras, fifteen days journey north of Bijapur (Bijengalia), there is a mountain which produces diamonds The method of obtaining them, which he describes on hearsay, is similar to that of the celebrated Arabic myth which the travels of Sindbad the sailor and of Marco Polo have made familiar to every one

The idea of the diamonds being collected by throwing pieces of meat freshly cut from a slaughtered cow or buffalo into a valley inhabited by venomous serpents, which pieces, with diamonds sticking to them, were picked up by birds of prey and recovered from them by the diamond-seekers, probably took its rise from some sacrificial custom in connection with the worship of the sanguinary goddess of riches, whom Heyne ("Tracts," p. 95) alludes to under the name of Ammarwaru, as the partners of the mine. The pieces of meat cut from the victim were probably thrown about over the ground, and were naturally picked up and carried off by the birds. This I believe to have been the foundation upon which the fabulous superstructure was erected.

Beeragurh, or Wairagarh, is, as the crow flies, about 324 miles from Bijapur, northwards, and the distance might therefore have been accomplished in fifteen days

In the name *Al*benigaras there is sufficient resemblance to the name Beeragurh with the Arabic prefix *Al* to make it probable that they were identical. V. BALL

Calcutta, January 12

NOTES

WE hear that good progress is being made with the reprint of the late Prof A. H. Garrod's scientific papers, the publication of which may be expected early in the summer. It will form a volume of about 500 octavo pages, illustrated by more than thirty plates and about 200 woodcuts. Mr Hubert Herkomer, A.R A , the well-known artist, has most kindly undertaken to execute an etching of the late professor, as a frontispiece to the volume. The edition will be limited to a very small number of copies only, most of which are already subscribed for. Those who wish to add their names to the list of subscribers before it is closed, are requested to communicate at once with the secretary of the Garrod Memorial Fund, 11, Hanover Square, W., who will also be glad to receive subscriptions already promised Cheques to be crossed "London and County Bank, Hanover Square."

WRITING to the *Times* on Friday last, Mr Sclater calls attention to the fact that the collection of birds of the late John Gould, the ornithologist, had been offered to the Trustees of the British Museum for 3000*l*, and expressed a hope that there will be no difficulty on the part of the Treasury in sanctioning the expenditure The collection is stated to embrace about 1500 mounted and 3800 unmounted specimens of humming-birds, being the types from which the descriptions and figures in the celebrated "Monograph of the Trochilidæ" were taken. There are besides 7000 other skins of various groups, amongst which are splendid series of the families of Toucans, Trogons, Birds of Paradise, and Pittas.

THE following course of lectures will be given by Members of the Committee on Solar Physics appointed by the Lords of the Committee of Council on Education:—An Introductory Lecture, by Prof Stokes, Sec. R.S., April 6 A Lecture on the Practical Importance of Studying the Influence of the Sun on Terrestrial Phenomena, by Lieut-General Strachey, R E., C.S I, F R S ; April 8. Two lectures on the Connection between Solar and Terrestrial Phenomena, by Prof. Balfour Stewart, F R.S , April 27 and 29 Six lectures on Spectroscopy in relation to Solar Chemistry, by Mr J. Norman Lockyer, F.R.S., May 4, 6, 11, 13, 18, and 20 Three lectures on the Photography of the Infra-red of the Spectrum in its Application to Solar Physics, by Capt Abney, R.E , F R S , May 25 and 27, and June 1 The lectures will be delivered in the Lecture Theatre of the South Kensington Museum at 4 p m on the days stated above. Admission will be by tickets, which may be obtained, as far as there is room, on application by letter to the Secretary, Science and Art Department, South Kensington, S.W.

WE must remind our readers that the French Association will hold its next session in April at Algiers, beginning on the 14th. Those who have been enrolled members will have the advantage of half price for railway travelling, and of a special steamer from Port Vendres to Algiers This ship will leave Marseilles on the 11th, calling at Port Vendres on the 12th The lists were closed some time ago, but by addressing, without loss of time, M. Gariel, General Secretary of the Association, Paris, Rue de Rennes, all particulars relating to the excursions, which are very numerous and attractive, some of them including a tour in the Algerian Sahara, will be given. An industrial exhibition has been organised in Algiers, with races, *fêtes*, and inauguration of the Algerian Institute, which is directed by M. Pomel, Senator. Mr. F. Maxwell-Lyte, Hon. Foreign Secretary of the Association, Science Club, Savile Row, will be happy to afford further information to intending English visitors.

THE arrangements for the International Medical and Sanitary Exhibition are progressing so satisfactorily that it promises to be the most important Sanitary Exhibition hitherto organised in this country Applications for space are now being rapidly sent in, as the 31st inst is the last day fixed by the Committee for receiving them Up to March 15 applications for 984 feet had been received by the Committee. The Certificates of Merit which are to be given will be valuable awards to the public and to the successful exhibitors on account of the high character of the list of jurors, which already includes among many other the following:—Medical Section: Christopher Heath, F.R C.S , Wm. S. Playfair, M.D , Charles Higgins, F R C S., Chas S. Tomes, F.R S , Prof John Marshall, F R S., Dr Robert Farquharson, M P , the president of the Pharmaceutical Society, C. H. Golding-Bird, F R.C S , Lionel Beale, F.R.S., W B Carpenter, C.B., F.R.S., J. S. Bristowe, M D , Major Duncan, R.A , Surgeon-General Longmore, C B , E. H. Sieveking, M D., &c , &c.; Sanitary Section Sir Joseph Fayrer, K.C S.I , M.D , F.R S., Geo Aitchison, F R I.B A , Edwd C Robins, F.S.A , T. Roger Smith, F.R I B.A , F. J. Mouat, M D , Alfred Waterhouse, A.R.A., Capt Douglas Galton, C B , F.R.S., Ernest Hart, M.R C.S , Prof. Corfield, Wm Eassie, C.E, Roger Field, M. Inst C E., R. Thorne Thorne M B , Prof Prestwich, F.R S , &c., &c. In addition to the interest taken in the Exhibition by medical men, architects, and manufacturers, the general public have recognised the importance of the work thus initiated by the Executive Committee of the Parkes Museum of Hygiene by subscribing to the Guarantee Fund, which at the meeting of the Committee last Tuesday was reported to amount to 1026*l*. 7*s*. At this meeting the Secretary read a letter from Mr. MacCormac, the Hon Sec General of the International Medical Congress, forwarding the following resolution which had been unanimously passed by the Executive Council of the International Medical Congress at their last meeting:—"That the sum of fifty pounds be guaranteed to the Committee of the International, Medical, and Sanitary Exhibition, to be held at South Kensington in connection with the Parkes Museum of Hygiene, on the occasion of the International Medical Congress."

THE programme for the annual meeting of the Iron and Steel Institute on the 4th, 5th, and 6th of May has just been issued. The first item on the programme is the presidential address of Mr Josiah T Smith, the president-elect, whose experience as one of the earliest and for many years one of the largest stee manufacturers in this country, and as the head of the most extenworks of their kind in the world, will give his address an exceptional interest. The papers to be read cover pretty fairly the whole field of the manufacture and application of steel for shipbuilding purposes. A paper will be read by Mr. Alexander Wilson of Sheffield on the manufacture of armour plates. The subject of the manufacture of steel and steel plates will be dealt with by Mr. Sergius Kern of Russia, who will describe improvements recently practised in Russia, while the experience lately gained in the practical use of steel for shipbuilding purposes will be dealt with in a paper by Mr. Denny of Dumbarton, at whose works on the Clyde a considerable amount of steel shipbuilding has been turned out during the last two years. The important question of the relative corrosion of iron and steel will be discussed by Mr. William Parker of Lloyd's Another paper is promised by Capt. Jones, manager of the Thomson Steel Works, Pittsburg, on the manufacture of Bessemer steel and steel rails in America.

SCIENTIFIC honours are being paid to John Duncan, the weaver botanist. Recently the Inverness Scientific Society and

Field Club elected him an honorary member with a gift of 5*l.*, and the Banff Field Club gave 1*l.* 1*s.* When his story was first told by Mr. Jolly in *Good Words* in 1878, the Largo Naturalists' Society, one of the most active in the country, elected him an hon. member. The Edinburgh Field Naturalists' Club have lately issued a special circular and appeal on his behalf. Last week he was elected an hon. member by the Aberdeen Natural History Society, when a sketch of his life was given by Mr. Taylor, one of his pupils. Miss E. Brown has sent us 1*l.* for the John Duncan Fund.

WE see from a long article on the subject in the New York *Nation*, that the "Reports on the Total Solar Eclipses of July 29, 1878, and January 11, 1880, issued by the U.S. Naval Observatory," have appeared. We have not received a copy of the work yet, but from the article in the *Nation* it is evidently a valuable contribution to some of the questions suggested by solar eclipses.

THE Commission Supérieure of the Paris Electrical Exhibition has already deliberated on all the demands sent by French electricians. The utmost liberality has prevailed, and only a few technical questions have been reserved for more mature deliberation. But the authorisations will not be made definitive until after April 1, when the list of would-be exhibitors will be closed. The resolution of the Society of Telegraph Engineers and Electricians to organise the English section has been received with great satisfaction.

WE take the following from the *Gardener's Chronicle*:—Dr. Aitchison, Surgeon-Major in the Punjaub army, whose collections in the Kurrum Valley we alluded to on a former occasion, has returned from Afghanistan with another extensive collection of dried plants, and is now at Kew engaged in working them up. Amongst other interesting museum objects Dr. Aitchison has brought home specimens of *Chamærops Ritchieana*, a palm that covers miles of the alluvial plains with a dense bushy thicket. Frequently too it occurs as a branching tree fifteen to twenty-five feet high, but then usually in the vicinity of other trees or buildings. Dr. Aitchison's specimens illustrate this peculiarity exhibited by comparatively few other palms.

WE are glad to learn that the museum building begun some time ago under the auspices of the Perthshire Society of Natural Science is approaching completion. To equip and endow the museum a bazaar will be held in Perth towards the end of the year.

THE translation of Nägeli and Schwendener's treatise on the Microscope is approaching completion. Messrs. W. Swan Sonnenschein and Allen now announce its speedy issue to the public, which they trust will be effected during the present spring. The English editors, whose names will appear on the title-page, are Mr. F. Crisp (Secretary of the Royal Microscopical Society) and Mr. J. Mayall, jun., F.R.M.S., though several others have collaborated in the work. Messrs. Sonnenschin and Allen also announce for immediate issue an illustrated "Manual of Insects Injurious to Agriculture," by E. A. Ormerod, whose "Report of Injurious Insects for 1880" we reviewed in a recent number; and a second edition of "Prantl's Text-Book of Botany," by Vines, greatly revised, the first edition of which appeared last year.

WHERE is Mackay? "Here," we fancy a score of our readers will reply; but none of them would be "the real Mackay," as they say in the North, at least not the Mackay whose local habitation we inquire after. Happily we can answer our own question from the Christmas number of the *Mackay Standard*, a fact that shows that our Mackay must be considerably to the fore somewhere. "Mackay, according to the single archive at present extant to which we have been able to attain access, was first discovered by a gentleman of the name of Mackay, a Scotchman as his name would denote. That this is correct is more than probable, but it does not appear that, beyond giving his name to the place, he ever did anything to render himself famous. It may accordingly be accepted as a fact that he discovered the existence of the Pioneer River on which the town is situated, and the date of this discovery is placed at 1861, so that within a few days Mackay is twenty years of age. The Mackay District is in latitude 21° 10', and is situated at a distance of 625 miles to the north-west of Brisbane, on the Pioneer River." So then Mackay is nobody at all, but a flourishing new town (it would be a "city" in the States) in Queensland, with shipping and wharves and warehouses, and prosperous sugar-mills, and "Clifton-on-the-Sea," a fashionable summer resort of the Mackayites, twelve miles off. The municipality (3450 acres) is said to have fifty miles of streets under its control; there is nothing said about houses, so most of them may not have left the quarry or the brick-kiln yet. The population of the district is given as 7500.

ON Friday will take place at Père Lachaise the inauguration of the monument erected by public subscription to Crocé-Spinelli and Sivel, the two victims of the tragic *Zenith* ascent. Speeches will be delivered by M. Paul Bert, Professor of Physiology to the Sorbonne, who organised the ascent, M. Hervé Mangon, director of the Arts-et Métiers, who was the president of the Societé de Navigation Aérienne, then in office, and M. Gaston Tissandier, who was a party in the ascent, and escaped by a marvellous concurrence of circumstances.

ON Wednesday last week at 12.10 a.m. another shock of earthquake was felt at Casamicciola and Lacco Ameno. All the people fled to the open country; much consternation exists, as the people fear other shocks. Little damage was done, only a few injured walls and a tile factory have fallen. Vesuvius quiet.

A RATHER severe shock of earthquake was felt at Agram on March 17 at 3h. p.m., duration two seconds. It was accompanied by wave-like motions of the ground.

IT is announced that the entire length of the St. Gothard Railway between Airolo and the Lago Maggiore will be finished by the end of June; but the great tunnel, owing to difficulties about the vaulting, cannot be completed before November.

THE Conseil d'Hygiène of Paris has just issued a large 4to volume of 700 pages recounting all the precautions taken against several so-called "Industries Insalubres" practised in Paris. The work of the Conseil d'Hygiène extends over a period of five years, from 1872 to 1877, and relates to more than 200 industries in some of their essential details. Amongst the recommendations made are a refrigerating machine for dead-houses and a special establishment for cleansing contaminated objects with superheated vapours. Amongst the curious observations is the analysis of a parasitic vegetation developing on bread for the military. It appears the original sporulæ were brought from Germany by soldiers taken prisoners in the Franco-German war, returning home.

As the preparation of dynamite has acquired great importance, M. Gobi shows (*Memoirs* of the St. Petersburg Soc. of Nat.) that formerly the best dynamite was made with the "Kieselguhr" of Hanover, which can absorb as much as 75 per cent. of nitroglycerine, but is now made with the diatomaceous deposits from Randanne, in the department of Puy-de-Dôme, which can absorb from 73 to 78 per cent. of nitroglycerine. It is worthy of notice that both these formations have been described by Ehrenberg. It is obvious that the good quality of dynamite prepared from these two deposits depends upon the porosity of the small *débris* of the frustules of the microscopical diatoms, and that, when determining the qualities of a diatomaceous

deposit, we must take into account not only its purity, but also the size of the diatomaceæ it contains; thus, M. Gobi recommends especially those deposits which contain mostly frustules from the species of *Epithemia*, *Navicula*, *Synedra*, and *Melosira*, their frustules being of a greater size and more porous than those of the *Fragillaria*, *Cocconeis*, *Nitzschia*, &c. As to the use of pounded coal or bricks, and of sand, it ought to be quite given up.

AT the Annual Meeting of the Davenport (U S.) Academy of Sciences on January 6 a very satisfactory report was given of the condition of the Society and of the good work it is doing. The president gave an address, in which he sketched the progress which has been made in a knowledge of the Mound Builders, the prehistoric people of the Mississippi Valley, to whose remains the Academy has all along devoted special attention.

A SMALL well-printed *in memoriam* volume on the late Prof. Benjamin Peirce has been issued at Cambridge, Mass. It consists of the various notices, poems, addresses, &c., that appeared in consequence of his death, including three funeral sermons.

THE third *Annual Report* of the Dulwich College Science Society speaks hopefully of its condition. The Society has been steadily progressing, and has already collected a museum "which would do credit to many an older society." The *Report* contains abstracts of several of the papers and lectures given during the year.

AN encouraging Annual Report (the forty seventh) has been sent us from the York School Natural History Society, all its sections have evidently been doing well. In connection with this we are glad to notice that, under the title of the *Natural History Journal and School Reporter*, the journal conducted by the Societies in Friends' Schools has assumed a new and more attractive form, at the same time that its programme has been somewhat extended. The two numbers for February and March contain some creditable original papers.

A SECOND edition of Mr. W. C. Wyckoff's "Silk Goods of North America" has been published; the first edition was noticed in NATURE, vol. xx. p. 574.

THE additions to the Zoological Society's Gardens during the past week include a White-fronted Capuchin (*Cebus albifrons*) from South America, presented by Mr. C. Drake Sewell; a Ring-tailed Coati (*Nasua rufa*) from South America, presented by Mrs. Fuller, a Common Badger (*Meles taxus*), British, presented by Mr. Rocke, a Black-winged Peafowl (*Pavo nigripennis*) from Cochin China, presented by Mr. J. Marshall, a Rough-eyed Cayman (*Alligator sclerops*) from South America, presented by Mr. Arthur C. Ponsonby; a Horrid Rattlesnake (*Crotalus horridus*) from Brazil, presented by Mr. C. A. Craven, a Jararaca (*Trigonocephalus atrox*) from Brazil, presented by Dr. A. Stradling, C.M.Z.S.; a Macaque Monkey (*Macacus cynomolgus*) from India, deposited, a Goral Antelope (*Nemorhædus goral*), two Bar-headed Geese (*Anser indicus*) from India, purchased, a Javan Chevrotain (*Tragulus javanicus*) from Java, a Red Bird of Paradise (*Paradisea sanguinea*), a Twelve-wired Bird of Paradise (*Seleucides albus*), a Manucode (*Manucodia atra*) on approval.

OUR ASTRONOMICAL COLUMN

THE SOLAR PARALLAX.—In a communication to the Academy of Sciences of Paris on the 7th inst., M. Puiseux has discussed the observations of internal contacts during the last transit of Venus, which were made at stations occupied by the French expeditions. These include observations of second and third contacts at Pekin, St. Paul, Nagasaki, Saigon, and Kobé, and of second contact at Noumea. Seventeen equations are furnished by these data, and various combinations are made by Halley's method and by the method of Delisle. The former method supplies twelve separate results, the concluded parallaxes varying from 8″·78 to 9″·17, which are arranged according to the amount of the parallax factor: the simple arithmetical mean is 8″·98. On Delisle's method the combinations for second contact give fourteen values between 8″·86 and 9″·20, of which the mean is 9″·01, and those for third contact furnish ten values between 8″·63 and 8″·90—the mean being 8″·92. These figures considered with respect to others which have been obtained from observations of the same transit and on other methods, cannot be said to enlighten us materially as to the true amount of the sun's mean parallax. M. Puiseux thinks the observations of contact in 1874 have not given results so accordant as astronomers had looked for, but he nevertheless is far from discouraging efforts to secure observations of contacts in 1882, the phenomena in 1874 did not present that geometrical simplicity which had been formerly expected, but presented a succession of phases which were the more difficult to identify in the records of the observers according as the telescopes employed were more dissimilar; and he urges (1) that the different stations should be provided with telescopes of large aperture, to be employed under as identical circumstances as practicable, and (2) that the observers should be exercised "à l'aide d'appareils convenables," to appreciate in the same manner the appearances which the contacts may offer. The former consideration at least is too well understood as of paramount importance to be likely to be overlooked by any of the national committees now engaged in arranging for the most efficient observation of the transit in 1882.

VARIABLE STARS.—Minima of Algol occur by Schönfeld's formula on April 3 at 10h. 51m. G.M.T., and April 6 at 7h. 40m., and the next series observable in this country commences on May 13 at 14h. 17m.

In the uncertainty that exists with respect to the period of Ceraski's circumpolar variable, the following calculated times of minima are only to be regarded as rough indications:—

	h. m.		h. m.
April 3 ..	12 56 G.M.T.	April 18 .	11 58 G.M.T.
8	12 37	23	11 38
13	12 17	28	11 19

A constant period of 2·49326 days is here assumed. Prof. C. H. Peters publishes details of his observations of a number of new variable stars (*Astron. Nach.*, No. 2360), and Dr. Duner notifies the variability of the red star Schj. 57 *a*, which stands thus in the *Durchmusterung*:—

9·4m. R.A. 5h. 17m. 32s·7 Decl. + 34° 2′·1

This star was invisible in the Lund refractor on January 20, but was well seen on February 23, in September and October, 1878, he had confirmed its fiery-red colour, and found the spectrum of the Class III *b*. V Herculis varies from 8m. to 12m., and the period seems to be about 290 days, the next maximum may be expected in October of the present year.

ANCIENT ASTRONOMY.—In No. 2 of the new periodical, *Urania*, is an elaborate paper by Prof. Schjellerup of Copenhagen, "Sur le Chronomètre Céleste d'Hipparque," in which he discusses the question "Comment les anciens astronomes ont ils déterminé l'heure de la nuit, et à quelle exactitude ont-ils pu parvenir?" In this paper he has calculated by the strict trigonometrical formulæ (an investigation of which is prefixed) the positions of the forty-four stars mentioned in the third book of the only work of Hipparchus which has descended to us. His "Three Books of Commentaries on the phenomena of Aratus and Eudoxus," printed for the first time in 1567 (Lalande, "Bibliographie," p. 91) from two manuscripts of the Biblioth. Medicœa and the Library of the Vatican. Petau brought out a new edition, in which he availed himself of an ancient well-written manuscript preserved in the Bibliothèque Royale, and which forms part of the third volume of his "Uranologion." Prof. Schjellerup gives the Greek text essentially after the edition of Petau, with as nearly as possible a literal translation. He concludes his paper with the remark, "Dans l'état actuel on peut prouver que les Astronomes d'Alexandrie ont pu déterminer le temps sidéral presqu'à une minute près." It contains the right ascensions and declinations of the stars in question for every hundredth year, from − 300 to + 100, with the amount of proper motion to the respective epochs, and is a production which merits the attention of those who are interested in the Astronomy of the Ancients.

THE ACADEMY OF SCIENCES, PARIS.—At the annual public sitting of the Paris Academy on the 14th inst. the Lalande Prize

was awarded to Mr. E. J Stone, director of the Radcliffe Observatory, Oxford, for his great catalogue of southern stars, involving newly-determined places of all the stars observed by the French astronomer Lacaille during his memorable visit to the Cape of Good Hope, in the years 1751 and 1752; the observations for the catalogue having been made while Mr Stone occupied the position of Her Majesty's Astronomer at the Cape The commission to whom the consideration of the award was referred consisted of MM. Faye, Mouchez, Lœwy, Janssen, and Tisserand, who have called attention in their Report to the "fundamental importance" of the Catalogue, in view of the study of the proper motions, &c , of the stars in the southern heavens

At the same sitting the Valz Prize was adjudged to M. Tempel of Florence for his numerous cometary discoveries

The Damoiseau Prize (10,000 francs) has been again proposed for 1882 It had been offered without response in 1869, 1872, 1876, 1877, and 1879, the subject on all occasions being the same and a very important one in the actual state of astronomy, viz., "To review the theory of the satellites of Jupiter, to discuss the observations and to deduce the constants which it contains, and particularly that which furnishes a direct determination of the velocity of light, and lastly, to construct special tables for each satellite"

BIOLOGICAL NOTES

Algæ of the Gulf of Finland.—M Chr. Gobi made an excursion along the borders of the Gulf of Finland in the summer of 1879 with the object of investigating the algæ of this district. In spite of the weather being of the most unfavourable character he was enabled to work out the whole south-west coast of this district, from St Petersburg to the comparatively open sea at Hapsal. Along the southern coast of the Island of Kotlin, on which Cronstadt is built, and also along the opposite coast shore at Oranienbaum, chlorophyllaceous algæ were almost exclusively met with, and these belonging to species to be also met with in the fresh waters of the adjoining lands, for example, three distinct species of Cladophora (among these *C glomerata*), several forms of the genera Oedogonium, Spirogyra, Zygnema, and other filamentous Mesocarpeæ, various Desmidiaceæ (Cosmarium, Closterium, Scenedesmus), a much-branched, very fine, almost hair-like Enteromorpha (apparently *E. salina*), also various oscillatoriaceous forms and diatoms. Besides at Cronstadt an Ulothrix, more commonly in the early summer months, and a Merismopœdia (probably *M Kutzingii*) at Oranienbaum, the pretty *Spirulina Jenneri*, amidst various Oscillatoria, was met with, also Vaucheria, and in larger quantities *Hydrodictyon utriculatum*, in the various stages of development (middle of August) About seven versts west of Oranienbaum Tolypothrix was met with in some quantity, forming floating ball-shaped masses. By the end of July some excursions to the environs of Hapsal led to the discovery of the interesting Phæospore, which up to this had only once been found by Pringsheim at Heligoland, and called by him Streblonema, in Hapsal Bay it lived on Ruppia, several Charas, and in company on these with *Ulothrix confervicola*, which latter grew in great abundance on these plants and on Ceramia and other red algæ. It is interesting to note that along with marine forms there grew some of the fresh-water filamentous algæ, such as Spirogyra, Zygnema, and in large quantities that half fresh-water species *Monostroma Balticum* Out in the bay towards the open sea the red algæ increased in number, but the merging of the fresh water forms into those of a truly marine type could be well studied in the Bay of Hapsal. (*Botanische Zeitung*, February 20.)

The "Blake" Cruise —Numbers 1 and 2 of volume 8 of the *Bulletin* of the Museum of Comparative Zoology at Harvard College contain preliminary reports on the Echini collected during the cruises of the *Blake*, by Alex. Agassiz, and on the Crustacea by Alphonse Milne-Edwards, have just reached us. The report on the Echini contains descriptions of thirteen new species belonging to such genera as Dorocidaris, Cœlopleurus, Asthenosoma, Phormosoma, Palæotropus, and Schizaster. Perhaps no group of animals has received such marked additions to its ranks through the deep-sea dredging expeditions. There was a time, and that not long ago, when we remember that the prevalent idea was that in this class new species were scarcely to be expected to turn up. Alphonse Milne-Edwards' report, of which the first part only is published, treats of the Brachyurous Decapods and of a portion of the Macrura. Many new genera and species are described, and several are figured. One very remarkable new genus, Corycodus, is formed to receive a somewhat mutilated example, which however exhibits characters different from any known Crustacea, belonging apparently to the family Dorripedæ. Its carapace is globular, and intimately connected to (soudée) the sternal plastron and between the insertion of the articulations of the first and those of the second pair of feet there is to be found a considerable space Some very interesting new genera belonging to the Paguridæ are described Among the new species of the Galatheadæ there are no less than eleven belonging to the genus Munida; and a new genus allied to Munida, Galathodes is described with ten new species. It is evident that the number of species belonging to the Crustacea have been very largely increased by the deep-sea exploration carried on by the United States Coast Survey-steamer *Blake*.

Food of Birds, Fishes, and Beetles —The State Legislature of Illinois authorised at its last session an investigation of the food of the birds of the State, with especial reference to agriculture and horticulture, and a similar investigation of the food of the fishes, with especial reference to fish-culture As a result several Bulletins have been issued from the State Laboratory of Natural History, of which the last just received (No. 3) contains a report on the food of fishes by S. A Forbes, the director of the Laboratory, the class especially reported on being the Acanthopteri, and another on the food of birds by the same. A very interesting series of notes on the food of predaceous beetles, by F. M. Webster, is added. Many species are proved to be vegetarians, sometimes doing the growing crops a good deal of mischief.

Physiological Significance of Transpiration of Plants.—Prof. Weiss concludes from experiments (Vienna Acad. *Ans*) that transpiration is only prejudicial to the functions of plants, excepting the process of lignification of the cell-walls, which it favours, hence it is to be regarded as a necessary evil for plants Prof. Weiss also obtains striking evidence in favour of Wiesner's theory of heliotropism, and he seeks to prove that through transpiration certain inorganic constituents of the ground are carried to plants in excess, and are got rid of on the fall of leaves in autumn, and consequently that transpiration is also the cause of the influence exercised by the nature of the ground on the quantitative composition of the ashes of plants. The view that the stronger growth of non-transpiring plants is due to mere expansion of cells without simultaneous over-production of organic substances, is controverted.

Signs of Death.—Observations with regard to the last manifestations of life in animals variously killed have been lately made by Drs. Verga and Biffi (*Real. Ist Lomb Rend*). The following conclusions are arrived at.—1 in the higher animals, when sensibility, circulation, and respiration have ceased, the life of histological elements of the nervous centres, especially of the ganglionic system and the spinal cord, remains for a short time 2. Contraction of the pupil and of the spleen are effects of this reduced latent life, and more remarkable effects, in guinea-pigs, rabbits, and cats, are the constant and uniform movements of inward curvature, which have the significance of respiratory efforts, presented under like conditions by the dog and the ass 3. These movements appear in the animals whether drowned in water, or hung, or bled to death. 4 They indicate the point beyond which the organism loses the power of recovery.

Classification of Statures.—In view of the increasing need of exactness in anthropological descriptions, Prof. Zoja has lately proposed in the Lombard Institute a system of classification of human statures. He first constitutes three divisions, denoting by the terms *mesosoma*, *megasoma*, and *microsoma*, medium, high, and low stature respectively. At the ends of the series are added divisions for gigantic and dwarfish statures, *gigantosoma* and *nanosoma*. Each of these five classes is divided into three parts, on this plan · *medium mesosoma*, *hypermesosoma*, and *hypomesosoma*. To attach numerical values to all these fifteen divisions is more difficult The author makes 2·00 metres the division between very high and gigantic stature, and gigantosoma ranges from that point up to 2 51 m. or more (hypergigantosoma). On the other hand 1·25 m. is made the limit between very low and exceptionally low stature; and nanosoma ranges from this to 0·74 or less (hyponanosoma). Medium stature (or mesosoma) ranges from 1 60 m to 1 70 m.

Equus Prjevalski —The St. Petersburg Geographical Society has just published a pamphlet, by M. Poliakoff, on the

Equus Prjevalski, a new species of wild horse discovered in Central Asia. It was killed by hunters who were sent from the post of Zaisan, and its skull and skin were sent to the St Petersburg Academy of Sciences. M Poliakoff discusses at length the relations of this new species of horse to our domestic horses, and illustrates his memoir with drawings of the new horse and of its anatomical features.

SIR JOHN DALZELL'S ANEMONE.—Many of our readers will be glad to hear of the good health and wonderful activity of this celebrated sea anemone. From the annual address of the president of the Botanical Society of Edinburgh, as published in the recently issued part of this Society's *Transactions*, we learn that the late Dr. James M'Bain was the faithful custodian of that *Actinia mesembrianthemum*, which, among naturalists, has long borne the honourable appellation of "Granny," and which, though having entered upon her fifty-second if not her fifty-ninth year of existence, has not yet ceased to people the waters with her progeny, for from the 4th day of March, 1879, to the 4th day of October in the same year, on which occasion the last official registry of birth occurs, she has given origin to twenty seven young ones. This is nothing to her prolific powers in 1857, for in one single night in that year she gave birth to no less than 240 young ones. This would have put Priam himself to shame, seriously alarmed Malthus, and taxed all the energy of all the accoucheurs in Edinburgh and its surrounding districts. She was gathered from the rocks at North Berwick by Sir John Dalzell, and at his death was handed over to the care of Prof John Fleming, then to Dr James M'Bain, he on the prospect of his decease was most solicitous to find a proper guardian for such a treasure. Some to whom he spoke declined to undertake so responsible a duty, till at last Mr Sadler, the curator of the Royal Botanical Gardens at Edinburgh, cordially responded to the request, and when last heard of the old lady was doing well.

GEOGRAPHICAL NOTES

AT the meeting of the Geographical Society on March 14 Mr James Stewart, C.E., of Livingstonia, read a paper on Lake Nyassa and the Water-route to the Lake-region of Africa. In his preliminary observations he remarked upon the fact that, though the lake is but 350 miles in length, no fewer than seven different languages are spoken on one side only, all belonging to the Great Bantu group, and that natives from the south end cannot understand those at the north end. He dwelt upon the advantages the Livingstonia missionaries enjoyed for performing geographical work at an exceedingly small cost, though their other duties prevented them from doing very much. Mr. Stewart afterwards gave an account of his journey up the western side of the northern part of the lake and thence to Tanganyika and back. During this he passed one stream, the Mera, which he thinks may be considered one of the most remote of the sources of the Congo. Mr Stewart concluded by stating that he was shortly about to return to Lake Nyassa, where he hoped to have opportunities for resuming his geographical work in opening a route to the south end of Lake Tanganyika.

WE have the new numbers of several geographical journals before us. In the March number of *Petermann's Mittheilungen* Herr Richard Buchta describes his journey, in considerable detail, to the Nile Lakes in 1878. To accompany a map of the South Argentine Pampas Herr H Wichmann summarises the latest information we have on that region. M. Sibiriakoff describes his journey in the *Oscar Dickson* to the mouth of the Jennissei in 1880. This number contains the geographical necrology of the past year, besides the usual monthly summary.—In the *Zeitschrift* of the Berlin Geographical Society Herr C. J Büttner in a long paper gives some valuable directions for the study of the Bantu group of languages. Herr K Himly has a short paper on some of the forms of Turkish, Mongolian, and Chinese names of places in books of geography. Herr Gustav Niederlein describes in a long paper some of the scientific results of an Argentine Expedition to the Rio Negro in Patagonia. Appended is a reproduction on a large scale of Dr. Kiepert's map of the new boundaries in the Balkan Peninsula.—In the *Verhandlungen* of the same Society is a paper by Herr K Kessler on the Caucasus and their exploration, and some valuable remarks on the thickness of the ice formed each year in the Arctic regions, and its connection with Arctic temperatures.—The first number of vol. iv. of the *Deutsche geographische Blätter* (Bremen) contains a long paper by Dr. Lindemann on the woods of the Bavarian Spessart, and by the same author a summary of recent Arctic work.—To the December number of the *Bulletin* of the French Geographical Society M De Castries contributes a paper on the region of the Wed Draâ; M. Ch Velain, geological notes on Upper French Guiana, and M. H Duveyrier, on the question of the sources of the Niger.

DR. RAE sends us the following extract from a letter to him by Capt Howgate, dated Washington, March 4, 1881:—"I write . . . to tell you that Congress has given the appropriation asked for the continuance of our work *viâ* Lady Franklin Bay, and also for an expedition *viâ* Behring Strait—ostensibly to look after the *Jeannette*, but also to prosecute the work of discovery in that direction. In addition to this it is propable that the Signal Service will this year establish the Point Barrow station, making a noble programme of Arctic work for the United States, and one in which I take just pride, for it is the direct result of my persistent work, since 1877, in raising public interest in the cause."

THE preparations for the commencement of the survey of Eastern Palestine are now complete. The War Office have granted to the Committee of the Palestine Exploration Fund the services of Lieut. Conder, who executed most of the survey of Western Palestine, and Lieut Mantell, both of the Royal Engineers. The party will include the two non-commissioned officers (now both pensioners) Black and Armstrong, who first went out in the year 1871. Lieutenants Conder and Mantell started for Beyrout on Tuesday evening, March 15, and the men will follow with the instruments. The work will be commenced in the north—the land of Bashan.

FROM a Buenos Ayres paper we learn that the long-promised exploring expedition to Neuquen, the most fertile spot perhaps in all South America, and part of the territory secured by General Roca's memorable expedition, has at last started, and important results are expected from it. This territory lies along the foot of the Andes, is watered by innumerable streams flowing from the great range into the Rio Neuquen, one of the two rivers which form the Rio Negro, and presents facilities for agriculture unknown in any other part of the Republic.

THE current number of *Les Missions Catholiques* contains a long letter from Père Schmitt, written from Mboma on the Lower Congo, in which he describes a journey lately made to the foot of the Yellala Falls. He paid a visit to the station of the Livingstone (Congo) Inland Mission at Matadi or Matavi, which is situated on the left bank of the Congo, opposite Mr Stanley's settlement at Vivi. Owing to the whirlpools in the river, landing at Matadi was accomplished with great difficulty. From Père Schmitt's account, the spot hardly appears to have been well chosen, being a melancholy sort of place, covered with rocks, as its name imports. The mission establishment consists of five or six tents, the interior of which reminded the visitor of a bazaar. On the return journey Père Schmitt spent a few days at Noki, where he had an opportunity of collecting information respecting the Congo region from the son of the king, who had been educated at St Paul de Loanda.

ACCORDING to the *London and China Express*, the sole obstacle to the contemplated maritime surveying operations in China and Japan, under the direction of the United States Hydrographic Office, has been removed by the consent of the Russian Government to the occupation of an astronomical station at Vladivostock by United States naval officers. They are to proceed there at once, and by telegraphic exchange of time signals, working from Vladivostock through Japan and China to Madras, will determine with great exactness the longitudes of Yokohama, Nagasaki, Shanghai, Amoy, Hong-kong, Manila, Saigon, and Singapore.

THE Wellington correspondent of the *Colonies and India* states that the New Zealand Government have just succeeded in acquiring a large tract of land at Rotorua, in the famous Hot Lake district, every acre of which the Maoris have hitherto jealously preserved. Even now tourists from all parts of the world visit this wonderful and beautiful district, but, when it is made more accessible, it is thought that Rotorua will become a great sanatorium for India and the colonies.

KING OSCAR of Sweden has just conferred decorations on Prof. Virchow, Dr. Nachtigal, and Herr William Schönlank, in recognition of their services in the cause of geographical discovery and commerce.

DR. BAYOL has been deputed by the French Minister of Marine to explore the upper part of the Niger.

ON THE CONVERSION OF RADIANT ENERGY INTO SONOROUS VIBRATIONS[1]

MESSRS. GRAHAM BELL and Sumner Tainter (American Association for the Advancement of Science, Boston, August 27, 1880) have shown that under certain conditions intense rays of light, if allowed to fall with periodic intermittence upon thin disks of almost every hard substance, will set up disturbances in those disks corresponding to this periodicity which result in sonorous vibrations. Mr. Bell (*Journal* of the Society of Telegraph Engineers, December 8, 1880) has subsequently shown that such effects are not confined to hard substances, but that they can be produced by matter in a liquid or gaseous form.

These discoveries have elicited a considerable amount of interest, and have led to the inquiry whether the sonorous effects are due, as the discoverers themselves surmised, to *light*, or as the president of the Royal Society, Prof. Tyndall, and others have suggested, to radiant *heat*.

Messrs. Bell and Tainter have partially answered this question by showing that the disturbances are not necessarily due to light, for they found that sheets of hard rubber or *ebonite*—a substance opaque to light—do not entirely cut off the sounds, but allow certain rays to pass through, which continue the effect. M. Mercadier, who has studied the subject with great care (*Comptes rendus*, December 6, 1880), has shown that the effects are confined to the red and ultra-red rays. Moreover Mr Bell has shown that gases, such as sulphuric ether, which Prof Tyndall has proved to be highly absorbent of heat rays, while they are transparent to light rays, are remarkably sensitive to this intermittent action. Dr. Tyndall has more recently read a paper before the Society (*Proc.* Roy. Soc., January 3, 1881) proving that these sonorous effects are a function of all gases and vapours absorbing radiant heat, and that the intensity of the sounds produced is a measure of this absorption.

The negative proof of Messrs. Bell and Tainter can be rendered positive if it can be shown that ebonite is *diathermanous*.

By very careful experiments made upon the diathermancy of different materials, ebonite proved to be as diathermanous as rock-salt.

It is therefore clear that the sonorous vibrations of Bell and Tainter are the result of disturbances produced by some thermic action rather than by any luminous effect.

Now the questions arise, Is this thermic action expansion and contraction of the mass due to its absorption of heat? Or is it a disturbance due to molecular pressure similar to that which produces the rotation of the radiometer? Or is it due to some other cause?

The argument against the first assumption when applied to hard disks is that *time* is a material element in such actions, and that the rate of cooling of warmed diaphragms is too slow to admit of such effects. Lord Rayleigh (NATURE, January 20, 1881) has questioned the validity of this argument, and has shown that if the radiating power of the body experimented on were sufficiently high a slow rate of cooling would be favourable to rapid fluctuations of temperature. It became desirable to test this point experimentally. Very delicate apparatus was constructed for the purpose.

Heat from various sources and at various distances, from bright lime-light to dull heat from hot metallic surfaces, was allowed to fall through rotating vanes intermittently on different bodies, but notwithstanding every precaution, and the many materials used, not more than six interruptions per second could be produced, although the system was beautifully sensitive to the smallest changes of temperature.

It was evident from these experiments that the sonorous effects of hard disks could not be explained by the change of volume due to the impact of heat rays and their absorption by the mass of the disk.

Is the action then due to molecular pressure similar to that which produces the rotation of the radiometer?

It is quite true that the radiometer effect is one visible only in very high exhaustions, but Mr Crookes (*Phil. Trans*, 1878, Part i., § 220) detected "the existence of molecular pressure when radiation falls on a black surface in air of normal density."

Whenever radiant energy falls on an absorbent surface in air, such as a disk of blackened wood, its wave-length is degraded or lowered, and it is converted in thermometric heat. The molecules of air striking this warmed surface acquire heat, and move away from it with increased velocity, and as action and reaction are always alike in moving away, they give the body a "kick." Since there is no such action on the other side of the disk, there is a difference of pressure between the two sides which gives it a tendency to move away from the source of energy. The effect is very much smaller in air at ordinary pressures than in air at a very low vacuum, because in the former case the mean free path of the molecules is very small, and the rebounding molecules help to keep back the more slowly approaching molecules. Nevertheless, molecular pressure is experienced, and if of sufficient magnitude and rapidity, it ought to produce sonorous vibrations. It seemed probable that the element of time does not enter here so prominently as in the previous case, for the radiometer effect is a mere surface action of the disk, and not one affecting its mass. Hence it was hoped that the retarding effects would be eliminated. If the sonorous action, therefore, be due to a radiometer action, a difference of effect would be observed if the side of a disk *exposed* to the source of energy be either blackened by lampblack or camphor carbon, or if it be polished or whitened.

An apparatus was constructed similar in principle to that described by Messrs Bell and Tainter.

An ebonite disk well blackened on one side when exposed to the intermittent rays was found to produce sounds, while a similar ebonite disk equally well-whitened, gave slightly less intense sounds. A zinc disk blackened gave weak sounds, while a similar disk polished gave sounds much weaker. A mica disk blackened gave scarcely any sounds at all, while a clean mica disk gave slightly better sounds.

These effects were produced many times and on different occasions, and they were so unsatisfactory as to throw doubts on the accuracy of the radiometer explanation. They were not so decided as theory led one to anticipate. The effects produced by the zinc disk, though very weak, favoured the theory; those given by the mica disk completely refuted it, while those given by the ebonite disks were almost of a neutral character.

The question occurred whether in Bell and Tainter's experiments *the disks vibrated at all.*

A delicate microphone was fixed in various ways on the case holding the disks. Although the sounds emitted in the hearing-tube were quite loud, scarcely any perceptible effect was detected on the microphone. Had the disk sensibly vibrated, its vibrations must have been taken up by the case. A microphone never fails to take up and magnify the minutest mechanical disturbances.

It was thus evident that the disk did not play a prime part in this phenomenon, but that the result might be due wholly to an expansion and contraction of the air contained in the air space behind the disk.

With a new clean case and an ebonite disk the sonorous effects were feeble, but if a lens were placed close in front of the ebonite disk, so as to make a second air space in front of the disk, the sonorous effects were magnified considerably.

The ebonite disk was fitted with an extremely delicate microphone, which in this case gave good indications upon the telephone, but whether the vibrations were the results of the vibrations of the disk itself, or of the air in which the microphone was placed, was doubtful.

If the lens were removed and the disk left supported without any air cavity, either behind or in front of it, *no perceptible sound could be obtained*, proving that the effects were really due to the vibrations of the confined air, and *not to those of the disk*. It was therefore determined to dispense with the disk altogether. The disk was therefore removed, the lens remaining; the sonorous effects were *nil*.

Another case was taken under similar circumstances, i.e. *without the disk*, but the effects were very loud—60; in fact, the best results which had yet been obtained. Now the only difference between the one case or cup and the other was that the one *was blacked in the interior*, and the other was not.

Hence the former case was again taken without the disk, and though when clean it gave no effect, when its interior was blacked by camphor smoke, it gave sounds as strong as the loudest effect yet produced. It was thus evident that the sonorous effects were materially assisted by coating the sides of the containing vessel with a highly absorbent substance, such as the carbon deposited by burning camphor. It remained to be seen how far the lens played a part in this phenomenon.

[1] Abstract of a paper by Mr William Henry Preece, read at the Royal Society, March 10.

The lens was now removed from the front of the case, and it was replaced by a movable glass plate (1·5 millims. thick); the sounds were the same, but they gradually ceased on gradually uncovering the front opening of the case, so as to give the air room to expand.

The glass plate was replaced by a heavy rigid plate of rock-salt 13 millims. thick, and the sounds were equally loud. The plate was replaced by white note-paper. The sounds were very faint, but perceptible. It was replaced by thin cardboard, and the effect was *nil*.

Hence it is abundantly evident that these sonorous vibrations are due to the motions of the contained air, and not to those of the disk; that they are actually improved by the removal of the disk, that their production is materially assisted by lining the surface of the containing space with an absorbent substance; that they are dependent on the heat rays that pass through, and that they disappear when the rays are cut off from the air cavity by an athermanous diaphragm.

Dr Tyndall having shown in the paper already referred to, that water vapour responded actively to these intermittent actions, a clean empty one-ounce glass flask was taken and exposed to the intermittent beams. No sound was produced.

It was then filled with water-vapour by pouring a small quantity of water into it, and warming it in a flame; fair sounds were the result.

The flask was filled with the dense smoke from burning camphor, and the sounds were intensified considerably.

Another clear one-ounce glass flask was taken. When clear no sounds were heard. When filled with tobacco-smoke fair sounds, but when filled with heavy camphor smoke very loud sounds were obtained. One side of the flask was blackened on the outside, the other side remaining clear. On exposing the clear side to the light fair sounds were obtained, but on exposing the blackened side, *no sounds were produced*. The flask was blackened *in the interior* on one side only. When the blackened side was near the source fair sounds, and when it was away from the source better sounds were heard. When the flask was cleaned all sounds disappeared. A thin glass plate was now blackened on one side and placed in front of the case. When the black surface was outside *no sounds were obtained*. When the black surface was inside good sounds were the result. When the glass was cleaned the sounds became still better. An ebonite plate was similarly treated. When the blackened surface was outside fair sounds were obtained. When the blackened surface was inside very poor sounds were the result.

This being an anomalous result, several experiments were now made to test the behaviour of opaque and transparent bodies, when used as disks, for while in the previous experiments the effect was greatest when the blackened surface faced the interior, here we find the opposite result produced, viz., the greatest effect was produced when the blackened surface was on the exterior.

Several experiments were then made, from which it appeared that transparent bodies behave in an opposite way to opaque bodies. Glass and mica can be rendered athermanous and silent by making the carbon deposit sufficiently thick. Zinc, copper, and ebonite can produce sonorous effects by a proper disposition of carbon. The effect in these latter cases may be due either to molecular pressure, in fact to a radiometer effect, though very feeble in intensity; or it may be the result of conduction through the mass of the diaphragm, that is, radiant heat is reduced to thermometric heat by absorption by the carbon deposit on the *outside* of the disk, and this heat is transmitted through the disk and radiated to the absorbent gases in the interior.

Several experiments were made which fully establish the inference that the effect is one of conduction, and that the blackened surface of an opaque body like zinc acts as though the source of heat were transferred to the outside surface of the disk.

Tubes of various sizes and dimensions were now tried to confirm Messrs. Bell and Tainter's observations on tubes. They invariably gave out satisfactory sounds when the intermittent rays were directed into the interior of the tubes, which were always considerably intensified by blackening their interiors and closing the open end with a glass plate.

It was shown that there is a time element, and that the loudness of the note emitted depends upon the rapidity with which the contained air not only absorbs the degraded energy, but upon the rapidity with which it gives up its heat to the sides of the case and the exits open to it. Though the pitch of the maximum note varied with the cavity and the amount of radiant heat transmitted, its quality never varied, notwithstanding the great diversity of materials used as diaphragms.

Since these sonorous effects are due to the expansions of absorbent gases under the influence of heat, and since wires are heated by the transference of electric currents through them, it seemed possible that if we inclosed a spiral of fine platinum wire in a dark cavity, well blacked on the inside, and sent through it by means of the wheel-break, rapid intermittent currents of electricity from a battery, heat would be radiated, the air would expand, and sounds would result. This was done, and the sounds produced were excellent. In fact, with four bichromate cells sounds more intense than any previously observed were obtained.

Furthermore it was evident that if the wheel-break were replaced by a good microphone transmitter, articulate speech should be heard. This was done, and an excellent telephone receiver was the consequence, by means of which speech was perfectly reproduced.

The explanation of these remarkable phenomena is now abundantly clear.

It is purely an effect of radiant heat, and it is essentially one due to the changes of volume in vapours and gases produced by the degradation and absorption of this heat in a confined space. The disks in Bell and Tainter's experiments must be diathermanous, and the better their character in this respect the greater the effect, remove them, and the effect is greater still. Messrs. Bell and Tainter (*Journal* of Society of Telegraph Engineers, December 8, 1880) showed that the sounds maintained their *timbre* and pitch notwithstanding variation in the substance of the disk, and M. Mercadier found that a split or cracked plate acted as well as when it was whole. These facts are consistent with the expansion of the contained air, but not with any mechanical disturbance of the disks. Moreover M. Mercadier showed that the effect was improved by lampblack, but he applied it in the wrong place.

The disks may, and perhaps do, under certain conditions, vibrate, but this vibration is feeble and quite a secondary action. The sides of the containing vessel must possess the power to reduce the incident rays to thermometric heat, and impart it to the vapour they confine, and the more their power in this respect, as when blackened by carbon, the greater the effect. The back of the disk may alone act in this respect. Cigars, chips of wood, smoke, or any absorbent surfaces placed inside a closed transparent vessel will, by first absorbing and then radiating heat-rays to the confined gas, produce sonorous vibrations.

The heat is dissipated in the energy of sonorous vibrations. In all cases, time enters as an element, and the maximum effect depends on the diathermancy of the exposed side of the cavity, on its dimensions and surfaces, and on the absorbent character of the contained gas.

THE EARTHQUAKE IN ISCHIA

THE Island of Ischia, the Pithecusa of the ancients, is some twenty miles in circumference, and appears to be the continuation of the north-western boundary of the Gulf of Naples. It consists of an old volcanic mountain sloping down on all side to the sea. The southern rim of the old crater has been remove by denudation, leaving the northern as a curved serrated ridge, forming the peak of Monte Epomeo.

Situated on the southern slopes of the island are only a few and unimportant villages.

Going from east to west along the northern slope we have first the capital Ischia, then we encounter the great trachytic lava stream which issues laterally from the slope of Epomeo, and after a course of two miles entered the sea, forming a promontory. This is the so-called lava Del' Arso, of A.D. 1302. Next are encountered two very fresh-looking craters, from which lava streams have flowed. Then we come to Casamicciola, a small town of about 4000 inhabitants, to the north-west of which is the village of Lacco Ameno. At the eastern end of the island is the town of Forio.

The district in which are situated Casamicciola and Lacco is thus bounded on the north by the sea, on the south by the ridge of Monte Epomeo, on the west by a spur stretching from the latter into the sea, forming the Punta Cornacchia, and on the east are the two hills called Monte Rotaro and Montagnone, the new-looking craters already spoken of.

It is worth observing that from this side of the island the four or five historic eruptions have occurred, and all the principal thermo-mineral springs are confined mostly to this district.

It is at this very spot that the late earthquake has taken place, resulting in the total destruction of Casamicciola, with the exception of the hotels, baths, and a few well-constructed private houses. A hundred and twenty bodies have been excavated, and they are not all, besides 160 seriously wounded. At the village of Lacco thirteen houses have fallen, and five deaths are reported.

On March 4, at five and a half minutes past one p.m., a terrific shock shook the whole island, but its maximum intensity was at this point leaving Ischia and Forio almost uninjured, together with the villages on the opposite side of the mountain.

There was but a moment of premonitory trembling, when the terrific blow shook the houses about the ears of their inhabitants. The corpse of the shoemaker was found in his usual position, with the last between his knees, and we saw the corpse of a woman with the half finished stocking in her hand and the needle in its sheath. The two cases show the suddenness of the catastrophe.

The first shock was described as a sudden blow beneath the feet, followed by a series of undulations, which appear from accounts to have radiated from a point which I shall immediately describe. This was followed shortly by faint vibrations, accompanied by loud subterranean thunder, such as was heard in the slight earthquake of last July.

On visiting the island a few hours after we were struck by the severity of the shock and by its extremely limited area. Following the methods adopted by our eminent countryman Mr. Mallet, F.R.S., in his investigations of the great Neapolitan earthquake of 1857, we have come to the conclusion that the undulations occurred in a series of closed curves radiating from a point which must have been situated about a quarter of a kilometre to the south-west of the upper town, that is in the direction of Lacco.

It is interesting to note that the seismographs at Naples and Vesuvius were not at all affected by the earthquake. This led Prof. Palmieri to conclude from the extremely local effects produced that the phenomenon was due to the excavation and removal of matter by the mineral springs and the collapse and falling in of the superincumbent ground. It seems difficult to satisfy oneself with the theory of my respected teacher and friend Prof. Palmieri for the following reasons:—

1. The collapse of earth in Cheshire in no way produces effects at all similar or equivalent to those under consideration, and yet the amount of salt in solution removed is equal to much more solid matter than is removed by the dilute mineral waters of Ischia, which are also small in quantity. Landslips like that of Lyme Regis are quite incomparable in effects to the present case.

2. The waters that issued immediately after the disaster were as usual clear, and flowed at the same rate. If this explanation was tenable, then the collapse of the earth should have forced out a large body of water and vapour and have rendered the former turbid and muddy. Such however was not the case.

3. The disturbance in Ischia was coincident with the seismic movements that were felt in various parts of Europe from the 2nd to the 5th of March, and which was severe throughout Northern Italy.

We know from the following facts that Ischia cannot be reckoned amongst extinct volcanoes. The great number of fumaroles and thermo-springs that exist on its surface; the sand on the sea-shore in some parts is so hot a few inches from the surface that the hand cannot be borne in it, the continual seismic disturbances to which it was and is subject—all point to the conclusion that there still exists igneous matter not far from the surface.

The seismic waves of the beginning of March causing increased tension in the igneous matter through which they travelled would tend to rupture the superficial crust at its weakest point; the Island of Ischia presents to us such suitable conditions, and the volcanic matter, vapour, or lava may by those means have endeavoured to force its way towards the surface.

The formation of a fissure, together with the blow that would be produced by the immediate falling of such, would explain the phenomena. Much the same results occur from the formation of a dyke in an active volcanic mountain; in fact the conditions may be looked upon as analogous.

Although lava has failed to reach the surface on the present occasion, a repetition may be sufficient to produce an eruption such as has often occurred at this spot. We may look for the homologues of the present earthquake in that of A.D. 63, preceding the outburst of Vesuvius in 79, or those that disturbed Pozzuoli and its neighbourhood immediately before the formation of Monte Nuovo, but which were not felt at Naples.

The fact that the undulations produced little effect on the southern side of the island shows the extreme thinness of the earth-crust at this spot, the weight and bulk of the superficial configuration acting as deterrent agents to the propagation of the seismic undulations to any great distance. The earthquakes in Ischia have at times been very disastrous, compelling various Greek colonies to forsake the island. There is generally a slight shock about once a year, nearly always accompanied by subterranean thunder. These have sometimes caused injuries, as on February 2, 1828, when three or four houses fell and some thirty people were killed. The details of the observations being made will be published as soon as they can be formulated.

It is an interesting fact that since writing the above, on comparing notes with Signor P. Franco, my colleague, although our observations were quite independent and unknown to each other, yet we have arrived at exactly the same conclusion in almost every detail.

H. J. JOHNSTON-LAVIS

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The following notice respecting scholarships in Natural Science has been published by Merton College:—

There will be an election in June next to one (or two) Physical Science Postmasterships.

The examination will begin on Tuesday, June 28; it will be held in common with Magdalen College, and at the same time and place. Candidates may give in their names at either College, but all will be regarded as standing at both, unless special notice is given to the contrary. In the event of election a candidate will be requested to state which College he would prefer. The Postmasterships are of the annual value of 80*l*., and are tenable for five years from election, provided that the holder does not accept or retain any appointment incompatible with the pursuance of the full course of University studies. After two years' residence the College may raise, by a sum not exceeding 20*l*. per annum, the Postmastership of such Postmasters as shall be recommended by the Tutors for their character, industry, and ability. Candidates for the Postmasterships, if members of the University, must not have exceeded six terms of University standing, but there is no limit of age. The subjects of examination will be Chemistry and Physics. There will be a practical examination in Chemistry. Candidates will have an opportunity of giving evidence of a knowledge of Biology, but it must be borne in mind that in such cases the examiners will look for evidence of an acquaintance with the principles of Chemistry and Physics at least equal in extent to that which is required in the Preliminary Honour Examination in the Physical Science School. A paper will be set in Algebra and Elementary Geometry (Books I.-VI.), and a Classical paper of the standard required by the University for Responsions.

Magdalen College has published the following notice respecting Natural Science Scholarships (Demyships):—There will be an election at this College in June next to not less than seven Demyships, of which one at least will be Mathematical, one at least in Natural Science, and the rest Classical. No person will be eligible for the Demyships who will have attained the age of twenty years on October 10 next. The stipend of the Demyships is 95*l*. per annum, inclusive of all allowances; and they are tenable for five years, provided that the holder does not accept or retain any appointment which in the judgment of the electors will interfere with the completion of his University studies.

THE Oldham Lyceum and Science and Art Schools, opened by Lord Derby last Thursday, seems to be a handsome and useful building, and under Mr. Phythian's superintendence we have no doubt much good work will be done in the future as in the past. Chemical and physical laboratories and other arrangements of scientific work have been provided for.

SCIENTIFIC SERIALS

THE *American Naturalist*, March, 1881.—D. S. Jordan and Chas H. Gilbert, observations on the salmon of the Pacific.—J Walter Fewkes, the anatomy and development of Agalma, part 2.—A. J. Cook, on the relation of agriculture to science.—Wm H Holmes, glacial phenomena in the Yellowstone Pack.—E Holterhoff, jun., a collector's notes on the breeding of some Western birds

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti, vol xiv fasc. iii.—Results of observations on the amplitude of diurnal oscillations of the magnetic needle, made in 1880, at the Brera Royal Observatory, Milan, by S. Schiaparelli.—On Prof Cantor's new History of Mathematics, by the same.—Some observations on *verglas* and its theory, by Prof Serpieri.—On some post-glacial fissures in the southern Alps, by Prof. Taramelli.—A physiological sign of true death, by Doctors Verga and Biffi.—On sanguineous effusion in the bottom of the eye and in the cavity of the tympanum through death by hanging, by Prof. Tamassia.

Berichte uber die Verhandlungen der naturf Gesells zu Freiburg i. B, Band vii Heft iv, 1880.—On the optical structure of ice, by Fr Klocke.—On the behaviour of crystals in solution that are but a little short of saturation, by the same.—On torsion, by E Warburg.—The forms of vibration of plucked and rubbed strings, by F Lindemann.—Contribution to a knowledge of protozoa, by A. Gruber

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 17.—A paper by C Greville Williams, F.R.S, was read "On the Action of Sodium upon Chinoline"

The author, after giving a historical sketch of what he had previously done upon the subject, calls attention to the fact that for a yellow oil-like dichinoline to give a red crystalline hydrochlorate is probably a unique reaction He also states further on that the colour of this hydrochlorate is so brilliant that the finest vermillion looks brown by comparison His most successful preparations were made from chinoline purified by conversion into a crystallised chromate. The base so prepared is almost colourless, and becomes yellow with extreme slowness as compared with a product obtained without that precaution On treating chinoline with sodium, converting the resulting purplish fluid into hydrochlorate, separating the scarlet crystals by filtration, and fractionally precipitating with platinic chloride, he obtains several products, the most conspicuous being a salt of the formula $2(C^{18}H^{14}N^{2})HCl.PtCl^{4}$. Sodium amalgam reacts in a similar manner, and this appears to be the best way of obtaining the scarlet hydrochlorate of dichinoline in its greatest beauty

On recovering the chinoline unacted on from the mother liquors it had the same boiling-point as before the treatment with sodium, but on treating the recovered base again with sodium amalgam it yields a solid yellow resinous base, instead of the fluid one previously obtained. The author studies all the basic products by conversion into hydrochlorates, and fractionally precipitating with platinic chloride, and points out the remarkable similarity in the percentages of platinum obtained from the mother liquors of the scarlet hydrochlorate of dichinoline, from the scarlet salt itself, and from the hydrochlorate of the yellow solid base.

Zoological Society, March 15.—Prof W. H. Flower, LL.D., F.R.S., president, in the chair.—The Secretary read a report on the additions that had been made to the Society's Menagerie during the month of February, and called special attention to a female Bactrian Camel (*Camelus Bactrianus*), formerly belonging to Ayoub Khan, which Col. O. H. St. John, F.Z.S., has purchased from its captors at Candahar and presented to the Society, and to a male Wild Sheep (*Ovis cycloceros*), obtained from Afghanistan, and presented to the Society by Capt. W. Cotton, F.Z.S.—Mr. A. G. More exhibited some eggs of the Red-necked Phalarope, believed to have been taken in England; and an egg of the Tree-Pipit, taken near Dublin, this bird having been considered only doubtfully Irish. Mr. More also exhibited a specimen of the Red-crested Pochard, obtained near Tralee, being the first record of the occurrence of this species in Ireland.—Mr. R. Bowdler Sharpe exhibited a specimen of the so-called Sabine's Snipe (*Gallinago Sabinii*). This bird had been shot in July last by the Hon. W W Palmer at Woolmer Pond, near Selborne, Hants.—Prof. F Jeffrey Bell, F Z S., read the fourth of his series of observations on the characters of the Echinoidea. The present paper dealt with most of the genera of the Echinometiadæ, their systematic affinities were discussed and their relations to the Echinidæ shown to be so intimate as not to justify their separation into two distinct families.—A second paper by Prof Bell gave the description of a new species of the genus *Mespilia*, obtained at Samoa by the Rev S. J Whitmee, which the author proposed to name after its discoverer, *M. Whitmei*.—Mr W A Forbes read the fourth of his series of papers on the anatomy of Passerine birds The present communication was devoted to the consideration of some points in the anatomy of the genus *Conopophaga* and of its systematic position.—A communication was read from Prof. Newton, F R.S, in which he proposed to substitute the name *Hypositta* for *Hyphergus*, which he had formerly proposed for a genus of Passerine birds found in Madagascar.—A communication was read from Mr. M Jacoby containing descriptions of new genera and species of phytophagous coleptera.

Physical Society, March 12.—Sir W. Thomson in the chair.—New Members: Mr Colville Brown, Dr. J P Joule.—Col Festin read a paper by Capt. Abney and himself, on the absorption spectra of organic bodies The method of photographing the infra-red region of the spectrum gave better results for absorption than thermopile Organic compounds were chosen as giving the larger molecules The apparatus employed consisted of a small Gramme machine driven by a Brotherhood engine, and an electric lamp with a plevice for shifting the negative pole so as to get the crater on one side of the other carbon point The image of the positive pole was allowed to fall on the slit of the spectroscope - the light of the arc not being used Three prisms were used, and a camera with a back swing to it so as to get a considerable length of spectrum in focus. Maps of the various spectra were made with six inches of the substance examined inclosed in a glass tube Alcohols, acids, oils, and water were examined, and gave spectra of bands and lines. When hydrogen was absent in the compound there were no lines, and the authors conclude the lines to be due to hydrogen. Oxygen appeared to obliterate the space between the lines and make it a band. The authors hope by this method to detect the radicles present in a substance They found correspondences between some lines and lines in the solar map. Dr Coffin said that two kinds of chloroform, apparently the same, produced different physiological results the method might distinguish between these. Sir William Thomson thought it might throw light on the ultimate constitution of matter.—Mr Brown read a paper on the definition of work in text-books, and gave reasons for preferring that in Rankine's books

Anthropological Institute, March 8.—F. W. Rudler, F.G S., vice-president, in the chair.—The election of Dr. G D Thane was announced.—A collection of rubbings taken from door-posts and window-frames in New Zealand was exhibited They were chiefly interesting from the proof which they afforded of the clear influence of matted and woven materials on the ornamentation of stone architecture, a parallel to the influence of wood architecture on stone architecture pointed out by Fellowes in Lycia and by Lepsius in Egypt, also from the remarkable coincidence between some of these ornamentations and the outlines on the tombstones of Mykenæ, a near approach to the triglyph in New Zealand.—A short note by Mr. S. E. Peal, on Assam pile-dwellings, was read, and was illustrated by a series of sketches by the author.—Lieut-Col R. G. Woodthorpe, R E, read a paper on the wild tribes inhabiting the so-called Naga Hills on our North-Eastern frontier of India The paper dealt only with the Angami Nagas, who, it was stated, differ from all the other hill tribes of Assam in many important particulars, such as appearance, architecture, mode of cultivation, language, and dress In appearance they are a finer, cleaner, and better-looking race than their neighbours; they build their houses resting on the ground, and not raised on piles as all the other hill tribes of Assam (except the Khasias) do, and after a pattern not seen elsewhere. Differences in physical or topographical conditions do not account for this difference in the style of architecture, as the Angami villages are found on the same ridges as, and often not a mile from, villages constructed on the other principle. In dress the Angami differs most strikingly from all the other tribes in the kilt or short petticoat of dark cloth ornamented with rows of white cowrie

shells, the waistcloth of all other Nagas consisting only of a flap of cloth in front and behind, and often only in front The Angamis erect tall monoliths in commemoration of the dead or of some social event. These monoliths, often of great size, are dragged up hill on sledges running on rollers. The paper was illustrated by a large collection of specimens and drawings, and also by some fine diagrams, in the preparation of which the author had been much assisted by Mr. C. Holroyd

Royal Microscopical Society, March 9.—The president, Prof. P Martin Duncan, F R.S., in the chair —Swift and Sons' new "working" microscope and fine adjustment and the "Griffith Club Portable Microscope" were exhibited —Mr Powell showed *Amphipleura pellucida* with the vertical illuminator, and Mr. Stephenson pointed out that the illumination was not "opaque," as supposed, but that the diatom was illuminated by transmitted light reflected back by its own under-surface —Mr Crisp exhibited Prof. Abbes' radiation apparatus for showing the increased amount of light emitted by a radiant in glass or balsam compared to one in air —Mr. A D. Michael read a paper on a supposed new species of Acarus, *Dermaleichus heteropus*, and Dr. E. Cutter's paper on a supposed Infusorian in the nasal passage in cases of catarrh was explained by Mr. Stewart and commented on by the president —Discussions also took place on carbolic acid for mounting, and on the "Society" standard screw

Meteorological Society, March 16.—Mr. G. J. Symons, F.R S., president, in the chair —Rev A J. C. Allen, E Chapman, Rev. E W Ford, G T Gwilliam, H B. Jupp, A Ramsay, and J Stokes were elected Fellows.—The President gave a historical sketch of various classes of hygrometers, and described about 120 different patterns, after which an exhibition of instruments was held, showing various kinds of hygrometers, and also some new instruments which have been brought out since January 1, 1880.

Victoria (Philosophical) Institute, March 21.—Mr. J F. Bateman, F.R.S., read a paper on meteorology, in which he analysed the causes of a variation of rainfall in the United Kingdom In the discussion special remarks were made as to the causes and effects of the almost tropical rainfall that once obtained in these islands, after which a paper on Indian rainfall, by W P. Andrew, was read At the close of the proceedings it was announced that Prof. Balfour, F.R.S., would read a paper on the visible universe at the next meeting.

Edinburgh

Royal Society, March 7 —Lord Moncrieff, president, in the chair —The President read the second part of his paper on the rise of the constitutional idea In the half-century that elapsed after the publication of Buchanan's "De Jure Regni apud Scotos," important political changes were taking place and were shaping themselves, under the skilful hand of James VI. of Scotland, especially after his accession to the English throne, towards a despotism that would place the king alongside the arbitrary monarchs of the Continent. Charles I. however lacked the kingcraft to carry on successfully this policy of diminishing the power of the Parliament; and in 1644, in the heat of the contest between King and Commons, Samuel Rutherford published his "Lex Rex," which contains the first enunciation in the English language of the true *rationale* of the British Constitution. Passing on to the time of the Commonwealth, his lordship touched on the famous controversy on the divine right of kingship between Salmazius and Milton, a controversy which was continued by Hobbes and Harrington. Lastly, the paper discussed Algernon Sidney's work on Government, which was characterised as out of sight the best and ablest of the list.—Dr. D. J Cunningham, in a paper on the intrinsic muscles of the mammalian foot, gave an interesting account of several of the most striking modifications that occur in the arrangement of these muscles in different animals. The typical arrangement of three layers of four muscles each was found in certain marsupials, and the deviations from this typical arrangement could be grouped in two classes—those that resulted from division, and those that resulted from fusion. The peculiar modifications in the ox, horse, ape, baboon, gorilla, and man were specially referred to, many of these deviations being of the nature of degeneration or retrograde development.—Mr. A H. Anglin communicated a paper on the expansion of rational fractions — Dr. A. Macfarlane, in his third paper on the algebra of relationship, showed the nature of the problems that came under the scope of his symbolic method.—Prof. Tait communicated a note on a problem in kinetics of peculiar difficulty. One of two equal masses, originally balanced on an Atwood's machine, is set oscillating through a small arc. What is the subsequent motion? The equations of motion are peculiarly intractable, but may by suitable transformation be thrown into a form from which may be derived by simple inspection the general result that the oscillating mass moves under the action of a *downward* acceleration, so that the mixed potential and kinetic energies tend to become altogether kinetic. When both masses are set oscillating, a further complication is of course introduced, and it is found that the mass that is oscillating through the greater *angle* is subject to a downward acceleration.

Vienna

Imperial Academy of Sciences, March 17 —V Burg in the chair —C. Ludwig, studies made at the Physiological Institute at Leipsic during the time of 1879-80 —Dr. L. Boltzmann, enunciation of formulæ useful for determining the number of diamagnetism —Dr Synas Klemencic, relating to the determination of the proportion of the magnetical to the dynamical unit of the intensity of circuit —Dr F. Streintz, on decomposition of water on platinum-electrodes caused by the discharges of Leyden-jars —E. Ratkay, on *Exoascus Wiesneri*.—Prof. Dr. Edm. Reitlinger and Dr. F. Woechter, on the "disgregation" of electrodes by positive electricity and explanation of the figures of Lichtenberg —Dr P Weselsky and R Benedikt, a sealed packet containing the description of some new dyeing materials —Josef Wentze, on the flora of the Tertiary diatomeæ-slate at Sulloditz (Bohemia), central chain of mountains —H Schroetter, on the oxidation of Borneolacetate —E Stefan, on the equilibrium of a solid elastic body at a different or variable temperature —Dr Ernst v Fleischl, physiologico-optic notes.—Dr T. Puluj, on radiant electrode-matter (third paper).

CONTENTS

THURSDAY, MARCH 31, 1881

MIND IN ANIMALS

Mind in Animals By Prof. Ludwig Buchner, author of "Force and Matter," &c Translated, by the author's permission, from the German of the Third Revised Edition, by Annie Besant. (London Free-thought Publishing Company, 1880)

THE translation into English of Buchner's work on "Mind in Animals" (which was originally published in 1876) cannot but be welcome to persons of all shades of opinion, however greatly opinions may differ as to the auspices of the Company which has undertaken and published the translation The Company, among other things, undertakes the translation of works from foreign languages in the form of a series entitled "The International Library of Science and Free-thought," and of this series Buchner's work on "Mind in Animals" constitutes the first member It is to be hoped that the subsequent efforts of the Company in this direction will prove as useful and beneficial as the one we are about to consider The translation has here, on the whole, been well done, although occasionally we meet with an awkwardness of construction which a little more care in re-casting the sentences might easily have obviated. The work itself is without question a highly valuable compilation of facts relating to Comparative Psychology, and therefore its translation into English supplies a fitting occasion for our endeavouring to recommend it to the notice of English readers

Although the work is called "Mind in Animals," and fills between three and four hundred closely-printed pages, it only deals with the psychology of articulata, and even of this comparatively limited group it treats only of four orders, viz the *Hymenoptera*, *Orthoptera*, *Arachnida*, and *Coleoptera* No one, however, can read the work and feel that this limitation of its subject-matter is a defect, although in view of it the title might perhaps have been appropriately changed to "Mind in Insects"[1] As he says in his preface, "the author has not thought it necessary to widen the circle of his observations over the whole of the comparatively narrow and yet infinitely wide and rich sphere of intelligent insect life; he considers it better . to treat a single species thoroughly, rather than many species cursorily and superficially," &c Such being the author's aim, he appears to have read most of the existing literature upon the subject that is worth reading, and then made a compilation, tolerably well sifted, of all the more important facts These he has presented in a form at once highly entertaining to a general reader of the lowest intelligence, and most useful alike to the working naturalist and the evolutionary psychologist. The labour represented by the result is very considerable, and Buchner deserves all thanks and praise, both from the scientific and non-scientific public, for the patient industry with which, like the ant or the bee that he is so fond of upholding as a model, he has collected and arranged his materials.

More than three fourths of the book is devoted to ants and bees, and this portion constitutes a compendium of facts regarding the psychology of these interesting animals which we do not hesitate to regard as the most instructive that has hitherto been made There are however no original observations in the book—or rather no original observations recorded as made by Buchner himself, for there are several highly interesting observations recorded as made by friends and correspondents Some of the more important of these we may here present.

Herr Lehr, a "bee-keeping friend of the author," noticed that when his bees were attacked by dysentery, and "no longer able to retain their excrements, one hive suffered less than the others." Investigation showed that the bees of this hive had made a drain from the upper part of the hive, "where they were accustomed to sit together during the winter," to the exterior

The same (?) friend observed that when the wind blew down one of his hives and he replaced it, a few days later "the bees had left their old home in the lurch, and tried to enter other hives, clearly because they could no longer trust the weather, and feared that the terrible accident might again befall them"

Another friend, Herr Schluter, saw a hornet catch a cicada, sting it, and try to fly off with the bulky prey The hornet's strength not being sufficient to enable it to fly with the cicada from the ground, it dragged its burden up the stump of a mulberry-tree that stood close by. Arrived at the top of the stump—twelve feet from the ground- "it rested for a moment, grasped its victim firmly, and flew off with it to the prairies That which it was unable to raise off the ground it could now carry easily once high in the air"

Again, Herr Merkel communicates the following He saw a little grey wasp dragging a long caterpillar to its hole Arrived there, it put one end of the caterpillar over the hole, "and went to the other end and lifted it up so high that the caterpillar fell in But a piece of it stuck out", so the wasp pulled it out, and, laying it down near the hole, "went in again and brought out several little stones of the size of small peas It then again let the caterpillar fall into the hole in the way described' This time it was quite absorbed by the hole, and was buried by the wasp.

More interesting is an observation due to Herr Nottebohm, Inspector of Buildings at Karlsruhe, who carefully syringed off all the aphides from a weeping ash in March, to the great benefit of the tree But in June he was astonished to see multitudes of ants running up and down the trunk of the tree, busied in carrying up aphides all over the tree in order to re-stock it, and "after some weeks the evil was as great as ever."

Again Herr Theuerkauf showed Buchner a maple tree, round which he had "smeared about a foot-width of the ground with tar,' in order to check the mischief caused by ants cultivating aphides. But the ants on the tree turned back on finding the tar, and "carried down aphides, which they stuck down on the tar one after another, until they had made a bridge over which they could cross the tar-ring without danger"

Highly interesting also is an observation communicated to the author by Herr Kieplin concerning the Ecitons crossing streams, which is even more wonderful than anything that has been related of these wonderful insects by Bates or Belt. "If no natural bridge is available for the passage, they travel along the bank of the river until they arrive at a flat sandy shore. Each ant now seizes a bit of

[1] The Arachnida are called by Büchner insects, in accordance with popular usage

dry wood, pulls it into the water, and mounts thereon The hinder rows push the front ones even further out, holding on to the wood with their feet and to their comrades with their jaws In a short time the water is covered with ants, and when the raft has grown too large to be held together by the small creatures' strength, a part breaks off and begins its journey across, while the ants left on the bank busily pull their bits of wood into the water and work at enlarging the ferry-boat until it again breaks. This is repeated as long as an ant remains on the shore."

Similarly, Dr. Ellendorf informs the author that he has witnessed ants using a straw for a bridge across a saucer of water which he had placed as a barrier between the ants and his provisions He then pushed the straw about an inch from one of its two landing-places After much confusion and crossing of atennæ, the ants "soon found out where the fault lay, and with united forces they quickly pulled and pushed the straw until it again came into contact with the wood, when the communication was again restored"

The same observer communicates another very interesting observation on the leaf cutting ants He interrupted a marching column by placing a withered branch across their road The loads were laid aside by more than a foot's length of the column, and the ants began on both sides of the branch to tunnel beneath it, and when the tunnel was completed "each ant took up its burden again, and the march was resumed in the most perfect order"

These being the most important additions which Prof Buchner's work has made to our previous knowledge of insect psychology, we shall now proceed to make a few criticisms upon the work as a whole. In the first place, the author is not quite free from the failing common to less critical writers on animal intelligence, of admitting dubious cases without sufficient reserve Thus, for instance, on no better authority than Plutarch, he gives (p 57) a case "related by a certain Cleanthes," of ants going from one ant-heap to the entrance of another, carrying a dead ant Other ants came out of the visited heap, consulted with the bearers of the body, went back again and brought a worm "out of the depths of the nest, which was evidently intended to serve as a ransom for the dead body Then the ants which had brought the corpse left it lying there, and carried away the worm instead" He then adds, "However incredible this may sound, it is beyond doubt that ants and bees have been seen carrying away and even burying their dead, and of this further details will be given later" As the fact of "burying" is highly dubious, we looked forward from this statement to afterwards meeting with some new evidence upon the subject, but in the case of ants only found the unsupported assertion of Dupont, followed by a confusion of the well-ascertained fact that ants carry their dead away from their nests, with the inference that they bury them (p 167), while in the case of bees we only met with (p. 249) a very flimsy anecdote, which we had previously read in Watson's "Reasoning Powers of Animals," quoted from the *Glasgow Herald* on the authority of an anonymous correspondent; it presents a pathetic account of two bees flying out of a hive "carrying between them the corpse of a dead comrade," till, after searching for a suitable hole, they "carefully pushed in the dead body, head foremost, and finally placed above it two small stones. They then watched for about a minute before they flew away"—no doubt, of course, performing some appropriate funeral service. And this is the evidence on which the earlier statement rests, "*it is beyond doubt* that ants and bees have been seen . . burying their dead"! Such cases of careless judgment, however, in admitting alleged facts on wholly inadequate evidence, are fortunately in this work exceptional.

Another point on which criticism has to be offered is the frequent failure of references Important facts are constantly stated without any information being supplied as to the authority on which the statements rest. Again, even when the authority is stated, after the first time of quoting the reference is always to *loc cit*, so that unless the name of the work is carried in the reader's memory, he has to hunt back through an indefinite number of pages of letterpress till he finds it

Another feature of the work which must be considered a blemish upon it as a work of science, is a perpetual breaking out of allusions to matters religious and political. The strong bias which the author displays in these digressions, apart from being singularly out of place in a treatise which aims at scientific method, constantly leads him into obvious fallacies. For instance, when speaking of ants, he asks, "Why should we take it for granted that in a perfectly free community men would only work if compelled, when these animals give proof that such a free commonwealth is very possible, and is compatible with the voluntary work of all?" Certainly any one who is disposed to take such a supposition for granted, would scarcely be convinced by such a false analogy as that between an ant and a man; and he might very easily show up the nonsense by replying, "Why should we take it for granted that men in a perfectly free community *would* work without compulsion, when the grasshoppers give proof that such a free commonwealth is very possible, and is compatible with no work at all?" Such is the logic of many of these passages, and we do not think that in others of the same kind the sentiments are much more fortunate. It is, for instance, to be doubted whether the following picture of "the widest Socialism and Communism" as revealed in bees, and held out as an example for humanity to imitate, will prove as attractive to the eyes of all his readers as it evidently appears to the eyes of the writer. "They have no private property, no family, no private dwelling, but hang in thick clumps within the common-room in the narrow space between the combs, taking turns for brief nightly repose" (p. 266) On all such matters opinions may legitimately vary, but allusions to them are, as we have said, out of place in a treatise on Comparative Psychology.

Coming next to criticisms of a more purely scientific character, we have first to notice a meagreness with which the whole subject of instinct is treated. In his anxiety to combat the supernaturalists, Buchner errs on the side of too closely assimilating the psychological faculties of insects with those of men. That is to say, he endeavours to explain most, if not all, instinctive action as being one with "reason" and "reflection" But it is an enormous and damaging mistake in the cause of evolution to disparage the distinction which unquestionably exists between mind in animals and mind in man The function of an historical psychologist is to explain

the origin of instincts and the development of rational thought—not to slur the two together as presenting but little difference to be explained. Yet in two chapters devoted to instincts we have in this treatise scarcely a word to explain their probable mode of origin, and nothing to show how they may be supposed to have developed into reason. This "inverted anthropomorphism" constantly leads the author into statements which are little less than absurd—as, for instance, when speaking of the wedding-flights of bees he observes that their leaving the hive to copulate in the air "seems as though a feeling of modesty prevented the queen from performing this act before the eyes of the crowd"

Again, even in the few places where he does touch upon the origin of instincts, his treatment of the subject is most unsatisfactory. Taking, for example, his remarks on the difficulty presented by the case of neuter insects being derived from parents which display totally different instincts from their progeny, he adopts the view that fertile females were originally workers, lost their working instincts by degrees, but now leave them as perpetual legacies to their barren offspring. Now, although this view may be taken as a mitigation of the difficulty, it certainly cannot be taken as a full "answer" to it Buchner very lightly passes round a mountain of trouble where he says, "that this opinion, if correct, would also apply to the other social insects, and especially to ants, scarcely requires special argument" This is a most astonishingly complacent way of eluding what Darwin calls "the climax of difficulty" which is presented by several castes of workers having instincts differing, not only from their fertile parents, but from one another. The truth is that the theory advanced by Buchner is alone clearly inadequate to meet the facts, and he does not appear even to have read, or else to have entirely forgotten, the gem of condensed and candid reasoning upon this subject by which the beautiful theory concerning it is rendered in the "Origin of Species"

Lastly, even as to matters of fact there are some criticisms to be made. A serious sin of omission is to be complained of in the description of the habits of the leaf-cutting ants, in that no allusion is made to the theory of Bates—which having been since supported both by Belt and Muller, deserves to be regarded as highly probable, if not virtually established—concerning the object with which the leaves are cut and garnered, namely, to grow fungi upon. Again, in dealing with the so-called agricultural ant the author is, we think, somewhat too definite in his statements as to these insects planting seed. So far the remarkable story on this head rests on the unsupported authority of Dr Lincecum (not Linecum, as repeatedly misprinted), and although it may prove true, ought not, until amply corroborated, to be thus unreservedly accepted.

Other criticisms of the same kind might be passed, and we cannot help feeling it would have been well to have added a short chapter to the translation bringing the literature of the subject up to date, and likewise an index, but enough has been said to signify our general estimate of the work. In all matters of fact it is, as a rule, most accurate and comprehensive. In its philosophy it is not strong. But as a whole it is a decidedly valuable addition to the literature of Comparative Psychology.

GEORGE J. ROMANES

AMERICAN INDIAN LANGUAGES

Introduction to the Study of Indian Languages By J W Powell. Second Edition. (Washington Government Printing Office, 1880)

THIS is one of the most useful of the many useful works issued under Mr Powell's able management by the ethnological bureau of the Smithsonian Institution. It was originally published in 1877, and it is satisfactory to find that another edition has so soon been called for. At the same time one cannot but regret that this opportunity was not taken to somewhat modify the title, which, as it stands, is apt to deceive the unwary The book is in no sense an abstract treatise on the nature, structure, or classification of the American languages, either regarded independently or in relation to other forms of speech. It has nothing to do with the philosophy, or even with the grammar of these idioms taken collectively or individually Its object, if less ambitious, is perhaps far more useful in the present state of these studies. American philologists have confessedly shown a disposition to dogmatise on the morphology of the native idioms, and have indulged in some very wild speculation on utterly insufficient data regarding their origin, development, and affinities The old school of etymologists, who held that Eliot's Massachusetts Bible was merely a thinly disguised form of Welsh, that Delaware and Lapp were first cousins, and that Basque sailors stranded on the Brazilian seaboard could hold converse with the Tupinambas and other Guarani peoples of that region, has had its day But it has been succeeded by another, which, if slightly more cautious, is scarcely less extravagant, and which, notwithstanding the warning voice of science, still flourishes in both hemispheres. It will suffice here to refer to the astonishing theories seriously advocated by the late Abbé Brasseur de Bourbourg on the relations of the Maya-Quiché and Aryan families, by the Abbé Petitot on the Athabascan and Chinese, and quite recently by Mr. John Campbell of Montreal on "The Hittites in America." "The Aleutans and Barabra," writes the last-mentioned authority, "agree in being worshippers of the sun like other Hittites, in the manufacture of red waterproof leather, and in their manner of adorning the head. . . Physical ethnology would never have dreamt of uniting white Basques and Circassians, black Nubians, yellow Japanese, and red American Indians, but philology, which knows no colour but that of words and constructions, makes them one. It may be that in the Barabra we shall yet find the purest surviving form of the ancient Hittite language Some of its numerals help to connect those of the Peruvian dialects with other Hittite forms." One thing more surprising perhaps than such insanities is their appearance in the pages of a professedly scientific journal (*The Canadian Naturalist and Quarterly Journal of Science* for August, 1880, p. 359).

A wholesome check to writers inclined to indulge in tendencies of this sort is afforded by the modest and unpretending character of the work under consideration. It is put forward simply as a guide and aid to students in the collection of linguistic materials in a very wide field, where the labourers are still too few for the urgent and extensive character of the work to be performed. It thus brings us back to the domain of hard facts, wisely

reserving all speculation for a time when these facts will have been accumulated in sufficient number to afford a sound basis for more general inductions "The book is a body of directions for collectors" (Preface vi) It is divided into three chapters, one "On the Alphabet," another containing "Hints and Explanations," and a third supplying a large number of forms or "Schedules" to be filled up by the collector The chapter on the Alphabet aims at establishing some uniform system of spelling for all the native tongues, and puts forth a comprehensive scheme embodying many useful suggestions well deserving the attention of our "spelling reformers" These are summed up in a few fundamental rules, the chief of which are the exclusion of all characters and diacritical marks except those found in ordinary English printing offices, and the restriction of each sign to a single sound The difficulty of adapting the Roman system to the Indian tongues will be understood when it is stated that "there are probably sounds in each which do not appear in the English or any other civilised tongue, and perhaps sounds in each which do not appear in any of the others, and further, that there are perhaps sounds in each of such a character, or made with so much uncertainty, that the ear is unable to clearly determine what these sounds are, even after many years of effort" (p 2). Nevertheless the difficulty is manfully faced and largely overcome by the scheme here adopted, which is founded on one originally proposed by Prof. J D Whitney, and which is consequently at once scholarly, simple, and comprehensive A few improvements might here and there be suggested, but on the whole there is little to complain of, except perhaps the use of the circumflex (^), to mark both a long *a* sound, as in *all*, and a short *u* sound as in *but* Some confusion is caused by an awkward misprint at p 5, where this *â* appears instead of the German *ü*. It might also perhaps be better to indicate excessive vowel length by doubling the vowel as in Dutch, than by the clumsy addition of the sign + Thus *maan* rather than *ma + n*

Chapter II contains a number of well-digested and tersely-expressed remarks on dress, ornaments, dwellings, implements, food, colours, plants, animals, medicine, social organisation, kinship, government, and many other topics, which at first sight seem to have little connection with the subject of American philology But the author has wisely endeavoured thus "to connect the study of language with the study of other branches of anthropology; for a language is best understood when the habits, customs, institutions, philosophy—the subject-matter of thought embodied in a language are best known The student of language should be a student of the people who speak the language; and to this end the book has been prepared, with many hints and suggestions relating to other branches of anthropology" (Preface vi.). But besides these matters the chapter contains what will be welcomed as a boon by all linguists, a reprint of J. H Trumbull's masterly paper "On the Best Method of Studying the North American Languages," originally published in the *Transactions* of the American Philological Association, 1869-70, but strangely neglected by many subsequent writers on the subject. No other treatise perhaps of equal length contains so clear and philosophic an account of the peculiar genius and morphology of these polysynthetic tongues A great deal of space is devoted to the question of kinship, the true basis of Indian tribal society, and this intricate subject is fully illustrated by a series of four "kinship charts" or genealogical diagrams, which the original investigator will find of the greatest service in collecting and arranging his materials. The general student will also find them extremely useful in comparing the American systems of family relationship with those prevalent especially amongst the Dravidians of the Deccan and the Australian aborigines Too much importance has perhaps been attached to resemblances of this sort in tracing racial affinities, but their significance in the history of the evolution of human culture is undeniable Connubial society develops into kinship society, or the clan, in which all the members are blood relations, whence the tribe and nation It is remarkable that the connubial, or lowest form, still so prevalent in many parts of the eastern hemisphere, seems to have long disappeared, at least from the northern half of the New World, although some of its customs, especially those associated with kinship, still survive in the more advanced tribal state This explains the barbaric wealth of family nomenclature with which the Indian languages are still encumbered In the printed forms, or schedules, of which Chapter III exclusively consists, the terms of relationship occupy about forty pages, and include hundreds of complicate affinities such as, "my father's elder brother's daughter's daughter's daughter's daughter," "my father's mother's brother's son's son's son's son," "my mother's father's brother's son's daughter's daughter's daughter," "my mother's mother's sister's daughter's son's daughter's daughter," "my mother's elder sister's daughter's daughter's daughter's husband" For these, and even more intricate degrees of parentage, many native tongues supply equivalents, which the collectors are accordingly required to discover and insert in the blank columns prepared for the purpose in the schedules The arrangement of the other matter contained in these schedules seems to be somewhat needlessly involved. At least the advantages are scarcely so obvious as the inconvenience of breaking up the strictly lexical part into upwards of twenty sub-headings, instead of lumping the whole in one general vocabulary arranged alphabetically. Experience has abundantly shown how troublesome is the use of such minutely-classified lists of words even for the compiler This remark does not of course apply to the lists of sentences (Schedules 26-9), which appear to have been carefully prepared, and are well calculated to bring out the structure and varied grammatical forms of the Indian languages. A. H KEANE

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.

The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

Hot Ice

THE letter of Mr. Perry (NATURE, vol. xxiii p. 288) in answer to mine on the subject of Dr. Carnelley's experiment (p. 264) has remained a long time unanswered, partly because I

was led by the letter to suppose that Prof. Ayrton himself might have something further to say regarding his views as soon as he returned to England, but mainly because I did not see any point in it specially requiring an immediate reply. I find however that a considerable amount of cautious scepticism and suspense of judgment still prevail on the subject—a scepticism which Prof. Herschel's enthusiastic letter of a month ago (p. 383) has not gone far to remove, because, though there can be no doubt of his confirmation of the fact that ice in a hot vacuum is *infusible* and disappears slowly, there is nothing in his letter confirming the hypothesis that it is *hot*, which is the only point under discussion.

Now for my own part I fully and unreservedly accept this as a fact, not only on account of Dr. Carnelley's experimental evidence, but also because I imagine myself to perceive exactly why it occurs, and indeed that it might conceivably have been conjectured as probable beforehand.

My present communication therefore is merely to remove as far as possible any sense of mystification which Prof. Perry's letter may have tended to produce, and to indicate the ground of his error.

Professors Ayrton and Perry, with their stiff paper models, start, if I am not mistaken, on the assumption that the ordinary equations deduced from the two laws of thermodynamics will apply to the case; and this is exactly how I started myself. I considered that it was necessary to investigate the behaviour of a substance whose properties were defined, not by two independent variables, as is usual, but by three; the pressure, quantity of solid, and temperature, being all three arbitrary and independent of each other in the Carnelley experiment, and I extended Clausius's general equations to suit this case. But it was very soon evident that they did not apply at all, and for this reason, that the second law is only true for processes that are *reversible*, and the sublimation of hot ice is essentially an *irreversible* process. This is indeed the whole gist of the matter, and it is entirely due to this that the ice gets hot. Ordinary evaporation of a liquid below its boiling-point against a pressure less than its "vapour-tension" is an irreversible process, and accordingly the temperature is perfectly indefinite, and depends on the rate of supply of heat and on the rate of evaporation. So also with ice above the boiling-point, that is, ice subliming under a less pressure than the vapour-tension, its temperature depends simply on the rate of supply of heat and on the rate of evaporation. So far everything is perfectly simple and absolutely certain.

The only possible question that can arise is whether internal disintegration of the solid will not set in and prevent its rising above the boiling-point; whether in fact a solid cannot boil as a liquid does. I have given reasons for believing that in a solid formed *in vacuo*, or without air bubbles, and constantly rising in temperature, this will not occur, and I deny that under these circumstances it is in a particularly unstable condition analogous to that of superheated water on the point of "boiling by bumping."

This however I fully admit is a point distinctly open to discussion, and I imagine that without an experiment one could not feel at all certain about it. But personally I feel that the evidence already given us by Dr. Carnelley, together with the theoretical probability indicated in my former letter (p. 264), is sufficient and conclusive.

It was no doubt somewhat staggering to learn (NATURE, vol. xxiii. p. 341) that Prof. McLeod, with his well-known experimental skill, should have hitherto failed to repeat the experiment, or to get the ice at all above zero;[1] but I take this as an instructive example of those rare cases where refined experimental appliances are obstructions rather than aids, for I believe the failure to be simply due to the fact that Prof. McLeod's vacuum was far too perfect, and the evaporation therefore so rapid that the ice did not have a fair chance of showing its willingness to rise in temperature; it could not in fact get even as high as 0° C. But if Prof. McLeod will discreetly spoil his vacuum until the pressure is only just below the vapour-tension corresponding to the temperature shown by his thermometer, I have no doubt that he will see the ice rise to any temperature he likes, and he will find that when it is crossing zero it will be utterly regardless of the fact.

The same kind of statement applies to solid carbonic acid, on which I have made a few experiments with a view to raising its temperature. I squeezed it into the ice form in a hydraulic press (to diminish the evaporating surface), put a thermometer in it, and held it over a fire. The evaporation is so excessively rapid, however, that it remains apparently just as cold as before.

I have not time to follow it up just now, but the obvious thing is to put it under pressure, so as to diminish the rate of evaporation, and then heat it. Prof. McLeod informs me that the boiling point of CO_2 continues below its melting point (which is given by Frankland as $-57°$ C.), until the pressure is four atmospheres, so that anything just under four atmospheres may be applied to this substance with impunity, and it will then be exactly in the most favourable condition for the Carnelley experiment, and I have not the slightest doubt that it can then be warmed, and if at the same time the pressure be judiciously and gradually increased, that it can be made as warm as one pleases until it has all disappeared.

Experiment with substances other than water however are likely to be more difficult, simply because few substances have such a large latent heat both in the liquid and gaseous condition, and therefore few substances will be anything like so permanent and outlive the evaporation so long.

OLIVER J. LODGE

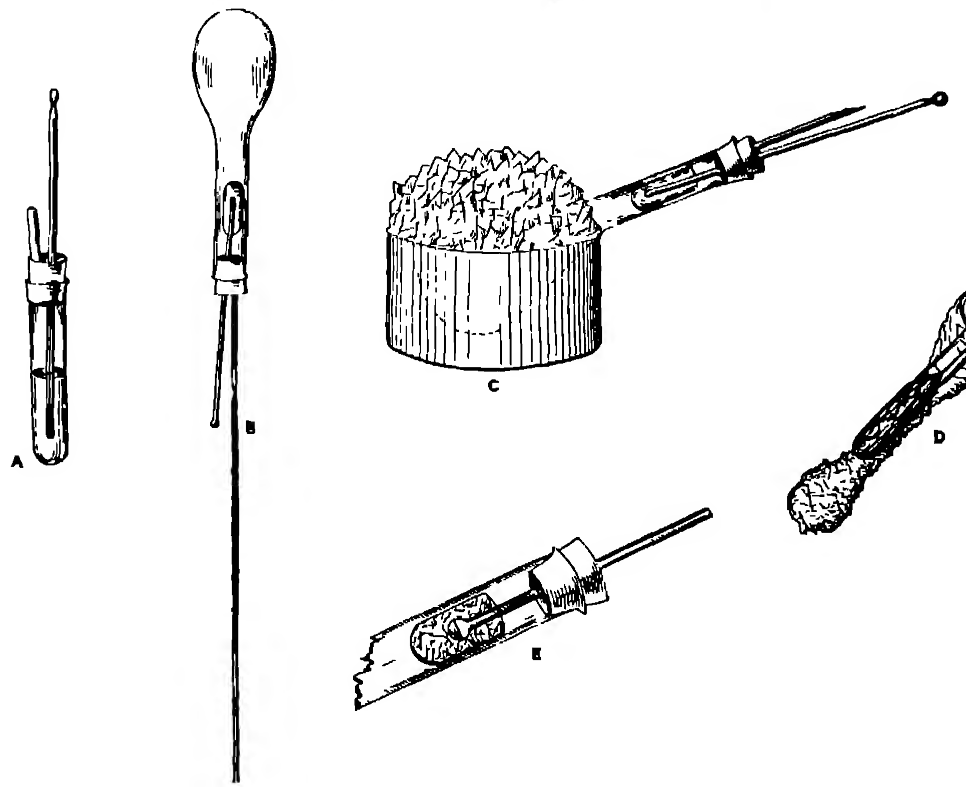
17, Parkhurst Road, N.

THE announcement made some time since by Dr. Carnelley that ice *in vacuo* could be raised to a temperature far above its ordinary melting-point, seemed so thoroughly in opposition to the experience derived from the great work of Regnault on the tensions of vapours, and as it called for a complete change of ideas in a field in which I am much interested, and as Dr. Carnelley asked others to repeat his experiments, I was induced to examine for myself the experiments on which so curious a statement was founded.

I used two different methods: the Torricellian vacuum and the Sprengel vacuum. As the experiment, as conducted by the Torricellian method, can easily be repeated by any one, and is much simpler in form than Dr. Carnelley's, I shall detail it. In the first place I wished to obtain a clear continuous piece of ice round the thermometer, as Dr. Carnelley's method gave flaky ice, which I found might lead to errors, owing to its discontinuity leaving the thermometer bare in parts. To obtain clear ice the following method was used:—Some distilled water was boiled in a test-tube A fitted with a two-holed stopper, with a thermometer through one hole dipping into the water; when all the air was expelled, a glass plug was pressed into the other hole against the issuing steam, and the whole allowed to cool, and then frozen in a freezing-mixture. A long-necked "German Florence flask" was then rinsed with distilled water and filled with mercury, and also placed in a freezing mixture. The tube A was then gently warmed with the hand, and the plug of ice adhering to the thermometer withdrawn. The glass plug in the second hole in the stopper was then replaced by a marine barometer-tube of about forty inches in length, having been drawn out about four inches from the top to facilitate sealing. The plug of ice round the thermometer was then inserted into the neck of the flask full of mercury, and the stopper pressed home. This caused the mercury to rise in the barometer-tube, and the whole was then inverted as at B; and when the mercury had all run out, the full tube was melted through at the constriction B, leaving a Torricellian vacuum above. The flask was now laid on its side in a freezing mixture and well covered over with ice and salt as at C. After a few minutes, to allow the receiver to cool, heat was applied to the neck of the flask with a Bunsen lamp, and even with a blowpipe, till the glass softened, but the temperature of the thermometer did not rise until some part of it became denuded of ice, or until air had been admitted. The experiment was repeated again and again, but in no case while the vacuum was intact could the temperature of the ice be raised materially above that of the receiver. If the temperature of the receiver was $-12°$, then the ice was a little over $-12°$, say about $-11°$, but never more than two degrees above the receiver, although the glass almost in contact with the ice was at its softening point. This is exactly what we would expect from Regnault's experiments; the temperature of the receiver determines the vapour tension, and therefore the "boiling point" of the ice. The ice was certainly never hot, and was not even

[1] Since this was in type I have received, by the kindness of M. Boutlerow, a copy of a paper read by him before the St. Petersburg Academy of Sciences, in which he summarises the views which have appeared on the subject, relates his failure to repeat the experiment, and confesses himself a sceptic. It would not be doing justice to M. Boutlerow's carefully-wrought memoir to discuss it in a foot-note, but it is my impression that his failure is due to the same cause as that which I have ventured to suggest above as accounting for Prof. McLeod's, viz. too perfect apparatus and too great experimental skill.

infusible, because when pressed against the hot glass it at once splashed out, freezing again in long thin flakes when it obtained free space for evaporation. All the heat passing to the ice is used up in volatilising it, and increase of the source of heat merely increases the rate of evaporation, as in the case of water boiling under atmospheric or other constant pressure; provided the condenser be efficient. These experiments were repeated with different thermometers and thicknesses of ice, varying from ½ inch to the thinnest film, $\frac{1}{16}$ inch, or thereby, and the temperature of the ice was always dependent upon the temperature of the receiver (when vacuous) and quite independent of the temperature surrounding it; the latter merely determining the rate of evaporation. Whenever a hole appeared in the ice covering the thermometer the latter rose, and if close to the hot glass rose rapidly. When the ice wore away, as shown at D, the temperature registered by the thermometer could be made either over or under zero. If the source of heat was made to play upon the top of the tube, then the temperature would read over zero say 6°, and if made to play on the bottom it would read $-8°$, the receiver being $-12°$. When however the ice was made to lie on the upper side of the thermometer by turning the latter round, the temperature could not be raised over zero, and sometimes not over $-4°$. These experiments were repeated by exhausting with a Sprengel pump, and it was invariably found that the pressure of the gas or vapour in the receiver determined the temperature of volatilisation of the ice, and when the "vacuum" contained only



water vapour the temperatures of the receiver and of the ice round the thermometer (however far apart they were placed) were practically the same. For instance, let the receiver be $-5°$, then the thermometer in the ice is also $-5°$ or $-4°$, now let the receiver be suddenly cooled to $-14°$ while the flame round the ice is urged to a higher temperature, the ice will nevertheless fall to $-13°$ or thereby, in short, the *temperature* of the "boiling" ice is determined by that of the receiver, while the *rate* of its "boiling" is determined by the temperature of the tube surrounding it. The ice remains perfectly dry, but if air be admitted or the receiver be raised above 0°, melting takes place.

As it has been objected that the thermometer might yield anomalous readings under such conditions (though why I cannot see), another method was tried, as shown at E. A small bulb blown on the end of a tube open at the other end, and containing a little water, had ice frozen round it, as in the case of the thermometer, and was then placed in the flask as before, so that there was a piece of ice under ordinary atmospheric conditions inclosed in the ice *in vacuo*. The tube round the outer ice was now raised to the softening point, but the ice in the bulb did not melt, and continued solid till the bulb was denuded of external ice by evaporation, showing that the ice *in vacuo* was never over 0°. It appears then that ice cannot be raised above 0° under any circumstances, and that the pressure determines the volatilising or "boiling" points of both solids and liquids, as Regnault's work would lead us to suppose.

J. B. HANNAY

Private Laboratory, Sword Street, Glasgow

BEING a reader of NATURE, I have become quite interested in Mr. Thos. Carnelley's experiments with hot ice. Although Mr. Carnelley's experiments would seem to be sufficiently accurate to prove that the ice was in a heated condition, I would still like to offer an additional method to heat the ice, and also a method to test for heat in the ice. To heat the ice I would suggest a small coil of fine platinum wire placed in position in the tube where the water is to be frozen, and the two ends of the coil passed through the sides of the tube and hermetically sealed.

If now the water be frozen around the coil, and a current of electricity passed through the wire of sufficient amount to heat the wire as much as might be determined upon, and the ice yet remain frozen, there would seem to be no doubt about the ice having become heated by contact with the hot platinum wire.

The method I would suggest to test for heat in the ice would be to take a couple of pieces of heavy platinum wire and pass through the sides of the tube and hermetically sealed as before, except to have a small space between the two ends of the wire on the inside of the tube, of one-eighth or one-quarter inch, or as much space as might be thought best.

If now the water be frozen between the ends or all round the ends of the wire, and a small battery and galvanometer be put in circuit with the terminals of the platinum wire, and a gas jet be applied to heat the ice, if the ice becomes heated the

galvanometer should show a stronger current of electricity passing, on the principle that most, if not all, non metallic substances that are conductors of electricity become better conductors on the application of heat. I judge that the galvanometer test would be a very perfect one. GEORGE D. RICHMOND

Lansing, Michigan, U.S.A., March 5

The Oldest Fossil Insects

I SHALL be glad if you will afford me an opportunity of explaining one or two personal matters referred to in p. 11 of Mr. Scudder's memoir on the Devonian Insects of New Brunswick, which was mentioned in your last number (pp 483, 4) He very justly takes exception to some bibliographical and orthographical errors committed by me in *Trans*. Entom Soc Lond. 1871, pp. 38-40, in a notice of fossil insects named and described by him, and naturally regards them as evidence of insufficient study of the literature relating to them It is difficult to say precisely what happened upwards of ten years ago, but I am satisfied that the mistakes must have arisen in one or the other of these two ways Either I attributed the authorship of the names to the person who first published figures of the fossils, on the ground that names bestowed upon insect-fossils by the publication of descriptions, without accompanying figures, rank as mere "Catalogue" or MS. names devoid of priority, or else they are due to circumstances under which the citations were collated. Closely pressed for time, and without much experience in the art of citation, it is as likely as not that, after forming an opinion upon the plates and consulting the letterpress to see what the author had to say about them, I referred from force of habit to the title page of the volume for the date of publication and the author's name, instead of turning to the heading of the article for this last

In the same page of his memoir Mr. Scudder alludes to the following passages in p. 39 of my work, over which we had some fun when he was last in England, though the strictures were not aimed at him more than at the others. "Palæontologists have adopted a ridiculous course with regard to some insect fossils. Whenever an obscure fragment of a well reticulate insect's wing is found in a rock, a genus is straightway set up, and the fossil named as a new *species*. The species is then referred to the *Ephemeridæ*, and is immediately pronounced to be a synthetic type of insects at present distantly related to one another in organisation This enunciation of synthetic types is often nothing less than a resort to random conjecture respecting the affinities of animals which the writer is at a loss to classify An insect allied to the *Ephemeridæ* which chirped like a locust (such as *Xenoneura* is imagined to have been), is a tolerable sample of these synthetic types. When a fossil comprises only a fragment, or even a complete wing of an Ephemerid, it is hardly possible to determine the *genus*, and impossible to assert the *species*. The utmost that can be learned from such a specimen is the approximate relations of the insect Neuration by itself is not sufficient to define the species or even the genera of recent *Ephemeridæ*" What I meant to be deduced from this was that, where in the nature of things actual precision is unattainable, palæontologists should be content to learn and state the "approximate relations" of fossil insects, and not presume upon the ignorance of scientific men in the matter of *genera* and *species*. And I further thought that the *Ephemeridæ* had served quite long enough as an asylum for fossil cripples, I wished to intimate gently that refuse of other groups of insects should be henceforth "shot" elsewhere.

Mr. Scudder does not know by whom the Devonian insects "have all been regarded as allies of the Ephemeridæ." My authority for stating such to have been the case is Sir John Lubbock's Presidential Address in *Trans* Ent Soc. London, v., *Proc.* cxxviii (1868), where "*Haplophlebium Barnesii* . . . is referred to the Ephemerina," and likewise "*Platephemera antiqua, Homothetus fossilis, Lithentomon Hartii*, and *Xenoneura antiquorum*" are said to be "all Neuropterous and allied to the Ephemeridæ." As members of this family they are quoted by Marschall. *Dyscritus vetustus* was not cited by Sir John; but since Mr. Scudder now states it (p. 22) to be "most closely allied" to Homothetus, there was no harm done in classing it with the rest.

The reason why I thought, prior to the publication of Dr. Hagen's letter in NATURE, that Platephemera might have been an Ephemeron, was that in some respects Mr. Scudder's figure presents an appreciable likeness to the neuration of the fore-wing in species of Palingenia, of which I possess unpublished drawings, but these certainly are not quite so odonatous in detail as Platephemera. Without inspecting actual specimens, it is hazardous to pronounce an opinion about fossils

A. E. EATON

Chepstow Road, Croydon, S W., March 28

Oceanic Phenomenon

FROM the description given by Dr Coppinger of the "confervoid alga" observed on board H M S *Alert* some 200 miles to the southward of Tongatabu (NATURE, vol. xxiii p 482), the conferva in question would appear to be of a species similar to that from which the Red Sea is said to obtain its name. Whilst proceeding up the Red Sea in H M S *Hornet* during the month of June of last year, I had many opportunities of observing the dirty-reddish scum on its surface—a phenomenon which must be familiar to all navigators of this sea Each of the little bundles composing it measured about $\frac{1}{25}$th of an inch in length and $\frac{1}{150}$th in breadth, and contained from twenty to fifty filaments, each filament being composed of a linear series of short cells, and measuring $\frac{1}{2000}$th of an inch in breadth I did not observe the discoid bodies referred to by Dr Coppinger, but their absence may be explained by assigning to this conferva a particular season for the production of these bodies Scattered among the bundles were tiny spherical bodies possessing a bristly appearance, which proved to be formed of a confused network of the filaments that composed the bundles

This conferva would appear to have a very wide distribution. It was observed by Mr Darwin near the Abrothos Islets which lie off the east coast of South America, and it is with regard to this phenomenon that the author of the "Journal of the *Beagle*" thus writes:—"Mr Berkeley informs me that they are the same species (*Trichodesmium erythræum*) with that found over large spaces in the Red Sea, and whence its name of Red Sea is derived In almost every long voyage some account is given of these confervæ They appear especially common in the sea near Australia, and off Cape Leeuwin I found an allied but smaller and apparently different species. Capt Cook in his third voyage remarks that the sailors gave to this appearance the name of sea sawdust" H. B GUPPY

17, Woodlane, Falmouth, March 28

The Banks of the Yang-tse at Hankow

AT the end of January, 1878, when the waters of the Yang-tse occupied their lowest level, I had the opportunity of examining the left bank of the river immediately below the foreign settlement. The bank, which varied from thirty to thirty-five feet in height, did not present a single perpendicular face, but was cut up into two or more terraces formed by the lingering of the waters at those levels for some extent of time A calcareous loam, homogeneous in appearance and dark in colour, composed the entire bank with the exception of the upper portion, where a layer of sand a few inches in thickness separated two layers of laminated loam, each of them of similar thickness. After a little trouble I was enabled to observe that the apparently homogeneous loam was made up of fine horizontal layers varying from one thirtieth to one-tenth of an inch in thickness, but the lamination was often concealed, and it was only where the loam had been freshly broken away that the layers were sufficiently distinct to be counted. Shells were embedded in the loam, but mostly in the lower half of the bank; those of the genus "Paludina" were the most abundant, whilst bivalves of the genus "Corbicula" occurred, but not in any numbers. The upper three feet of the river-bank were riddled with the burrows of annelids, and these burrows were often filled with little rounded masses of loam, evidently the excrementitious droppings of the worms.

If, as in the case of the alluvial valley of the Nile, it be considered that each of the fine layers which compose the bank of the Yang-tse was deposited during the periodic annual inundation of the river, then every layer will represent a year's deposit, and taking the average thickness of each layer to be one-twentieth of an inch, it would require twenty years to form an inch and a century to form five inches, whilst the whole thickness as exposed in the river-bank would require for its formation a period of between 7000 and 8000 years.[1]

[1] The borings and excavations round the pedestal of the statue of Rameses at Memphis enabled Mr Horner to estimate the rate of deposition of the alluvium of the Nile at 3½ inches in a century (*Vide* Lyell's "Principles of Geology")

It may be pertinent to the subject of this paper to remark on the general appearance of the region around Hankow. A vast alluvial plain extends to the horizon in all directions; whilst dotted over its surface are several shallow lakes, which are lost in the general flood of waters when the Yang-tse overflows its banks in the summer months Rising abruptly out of this alluvial formation are a few isolated groups of low hills, which in the time of flood stand out like islands from the surrounding waste of waters

It would be interesting to asertain whether the banks of the Yang tse possess this lamination whenever the river winds its way through an alluvial plain I noticed the same appearance in the low banks of the estuary near the village of Wusung; the horizontal layers varying in this instance from one-tenth to one-fourteenth of an inch in thickness Shells of both fresh-water and salt-water genera—"Paludina" and "Mactra"—were embedded in the bank H B GUPPY

An Experiment on Inherited Memory

WHEN I was a boy I had an electrical machine and Leyden jar; there was also a dog in the family. As a matter of course I "electrified" the dog, and ever afterwards during the remainder of his natural life he ran away in extreme terror when a bottle was presented to him

The recollection of this has recently suggested an experiment that may be made by some of the readers of NATURE By means of a small Leyden jar moderately charged startle *both the father and the mother* of an intended forthcoming generation of puppies. When these are full grown and away from their parents observe whether they are at all disturbed by the sight of a bottle or a Leyden jar, care being taken that the bottle is never shown to the parents in the presence of the offspring.

A single experiment will not be sufficient It should be tried by several, for which reason I suggest it here There is no more cruelty involved than in an ordinary practical joke It is not the pain of the shock, but its startling mystery that frightens the animal, especially if the shock is given by placing the jar on a piece of tinfoil or sheet metal, and allowing the dog spontaneously to investigate by smelling the knob of the jar while his fore-feet are in communication with the outer coating Under ordinary circumstances the dog obtains through his nose much information concerning the properties of things before he actually touches them, but in this case his whole life experience is contradicted by the mysterious, inodorous, diabolical vitality of the vitreous fiend. A bottle thenceforth makes upon the intellect of the dog a similar impression to that which a sheeted broomstick in a churchyard makes upon the similar intellect of a superstitious rustic. W MATTIEU WILLIAMS

Stonebridge Park, Willesden

Meteors

THREE very bright meteors were observed here during the month of December, 1880, and are, I think, worthy of record.

1. December 2, 1h 14m 50s a m. A meteor brighter than Jupiter descended towards the west point of the horizon, passing about 1° N. of Saturn, and somewhat farther from Jupiter, and in a line therefore nearly parallel to that joining those two planets The train was visible about three seconds

2. December 8, 10h. 55m. 30s. p m. A meteor as bright as Jupiter descended towards the north point of the horizon, about 1° below η Ursæ Majoris, its path being inclined at an angle of about 35° to the horizon The train was brilliant, but vanished speedily

3. December 24, 10h 4m p.m. A very bright meteor, seen through (or below) the clouds in the south-south-east, shot down towards the south-south-west point of the horizon, at an angle of about 30°. No stars were visible in that part of the heavens at the time. J. PARNELL

Upper Clapton, March 17

Classification of the Indo-Chinese and Oceanic Races

IN your issue of December 20 (p. 199), just to hand (February 12), I notice a contribution by Mr A. H. Keane on the classification of the Indo-Chinese and Oceanic races.

As the *Orang Semang* of the Malay Peninsula is only just referred to, I conclude that the author has not seen Maclay's papers on the wild tribes of the Malayan Peninsula in the second number of the *Journal* of the Straits Branch of the Royal Asiatic Society and a memoir by the same writer in the *Journal of Eastern Asia*, of which unfortunately only one number appeared. On the Jakuns, Maclay, who has probably seen more of their inner life and habits than any other ethnologist, writes as follows of the *Semang* and *Lakai* tribes.—"Logan" (*Journal of the Indian Archipelago*, vol. vii p 31, 32), "though differing from some others, says that the *Orang Semang* are certainly *Negritos*, but he calls them a mixed race According to my experience I must declare this also to be incorrect.

"From my own experience and observations I have come to the conclusion that the *Orang Lakai* and the *Orang Semang* are tribes of the same stock, that further, in their physical *habitus* and in respect of language they are closely connected with each other, and represent a pure unmixed branch of the Melanesian race; anthropologically therefore they absolutely differ from the Malays. The Melanesian tribes of the Malay Peninsula, chiefly because of the form of their skull, which has a tendency to be brachycephalic, approach the *Negritos* of the Philippines, and, like the latter, they do not differ very widely from the Papuan tribes of New Guinea"

In the fifth number of the *Journal* of the Straits Branch of the R A.S, Mr. Swettenham, the Assistant Colonial Secretary for the Native States S S, thus describes the *Semangs* of Ijoh —

"These people are short in stature, dark in colour, and their hair is close and woolly like that of negroes, with this difference, that all the men wear four or five short tufts or corkscrews of hair growing on the back of their heads, called *jamûl*"

During my botanical excursion through Perak in 1877 I had two *Semangs* as guides, answering to Mr. Swettenham's description

The Straits Branch of the R A S. is as yet in its infancy, having been established only in 1877, and its *Journal* has probably not yet secured a very wide circulation, although the five numbers that have been published contain probably more authentic information about the Malayan Peninsula than can be found elsewhere

The characters Mr Keane has employed to indicate the word "papûwah" are certainly not Malayan, at any rate it would be a matter of impossibility to secure the services of a Malay in Singapore who would be capable of deciphering them The word, which is a corruption of the Malayan or Javanese adjective *puwah-puwah*, is usually spelt thus— ڤڤوه

Writing about New Guinea, Crawfurd ("A Descriptive Dictionary of the Indian Islands," p. 300) thus expresses himself about the word Papua —"Some recent geographers have thought proper to give the great island the name of Papua, but an innovation which is correct neither in sound, sense nor orthography seems to possess no advantage over one which it has borne now for nearly three centuries and a half."

It may not be out of place here to remark that Messrs. Trubner and Co are the London agents of the Straits R.A S.

Singapore S S., February 12 H J MURTON

Fascination

IN the interior of the province Valdivia, South Chili, a species of wood-snipe (*Paipayen inc.*) is often caught by the natives in the following manner:—When the bird flies into one of the low bushes, which in spots of about three to six metres diameter are found frequently in the wood meadows there, two men on horseback go round it in the same direction, swinging their lazos over the bush. After ten or more rounds one man slips down from his horse, whilst the other continues, leading his companion's horse behind. Carefully then the first man creeps on to the point, where the paipayen is sitting nearly motionless or stupefied with the rider's circular movements, and kills it by a quick blow of a stick

When I first was told so I would not believe it; but in 1853 or 1854 I took part myself in this kind of capture in the hacienda San Juan, in Valdivia, belonging to my chief, Dr. Philippi, now professor in the University and director of the museum in Santiago. I had left the house without gun, accompanied by a native servant, when, in a part of the wood called Quemas, I observed a paipayen falling into a dense but low bush of the

above-mentioned kind Desiring to obtain a good specimen of this not very common bird for our collection, I expressed my regret at not having the gun, but the servant replied: "Never mind, if you wish, we will get the bird" And he caught it with my assistance in the above way without injuring it.

Marburg, March 16 CARL OCHSENIUS

Flying-Fish

JUNE 11, 1873, at sea 300 miles south of Panama, I saw a man-of-war hawk and a school of bonitos in pursuit of a school of flying-fish. As one of the latter came out of the water, closely pursued by his enemy, the hawk swooped down, not fifty yards from the ship, but missed his prey, the fish *apparently* turning from its course to avoid him. A second attempt was more successful, and the hawk flew off with the flying-fish in his talons. The whole affair was plainly seen, as also was the continued chase of the flying-fish by the bonitos

ALLAN D BROWN,
Commander U S Navy

U.S. Torpedo Station, Newport, R I, U S.A., March 10

THE OXFORD COMMISSIONERS ON PROFESSORS

WE are not disposed to agree with the outcry which has been raised in some quarters in reference to the proposition of the Oxford University Commissioners to enact certain regulations with the view of compelling Oxford Professors to reside in the University and to give lectures.

Some of the Commissioners' regulations relating to this subject appear to many to be ill-advised, but they have been improved by the recent modifications, and the general intention seems not only a right one, but also one which must be carried out whenever public opinion is brought to bear on the matter

A very simple view of the matter may be suggested The professors in the English Universities might be put on the same footing as are the professors in German Universities In those Universities the professors carry on abundant research, they also give very numerous lectures, usually what may be called "representative courses," that is, courses in which an attempt is made to present to the student the main outlines and much of the detail of the subject professed. Even in the Collège de France at Paris, which is *not* (strictly speaking) an educational institution, each professor is required to give an annual course of lectures (to the number of forty, we believe)

Research and the advancement of learning are, we do not for a moment doubt, the highest, and therefore in a certain sense the first business of University professors. It is perhaps because this is so generally admitted that the Commissioners did not at first insist upon it But it is in order that he may teach—not huge popular audiences nor cram-classes, but devoted thoroughgoing students—that the professor creates new knowledge. His best result is not new knowledge itself, but new youthful investigators ready and able to carry on the researches which he has commenced, and through which they have learnt method and gained enthusiasm. There is no stimulus to research so healthy and so sure as that afforded by the opportunity of converting a class of generous-minded young men into ardent disciples and loving fellow-workers

Hence, it may be maintained, there is no necessary antagonism between *true professorial teaching* (*i.e* definite courses of lectures) and the profoundest study and research

That the Commissioners have introduced no binding regulations with the object of forcing a professor to carry on research, is, we believe, a proof of wisdom and a just tribute to the dignity of such work. No regulations can make an investigator the question as to whether a given professorship will be used for the advancement of science and learning is decided before any regulations can have effect, viz, when the choice of a person to fill the post is made. If he is a "searcher" already, he will remain so, if he is not, a bad choice will have been made, and no regulations as to research can ever amend it. It is, however, well that the Commissioners have seen fit to improve their first set of regulations in so far as to state that an Oxford professor is *expected* to advance the study of the subject to which his chair is assigned.

The measures which the Commissioners propose for insuring the delivery of lectures by Oxford professors are objectionable on the ground that they are purely penal. They should be persuasive. The German professor is only too glad to give a thorough and attractive course of lectures if he has it in him to do so, because he thereby doubles or trebles the income which he derives from endowment The Oxford Commissioners have made a great mistake in prohibiting the professors from charging fees for the compulsory course of two or three lectures a week. All students, whether belonging to the professor's own college or not, should be liable to pay fees to the professors for attendance on their courses of instruction, whether lectures or laboratorial It is only by so arranging the position and endowment of a professor that he is both able and willing to increase his income by the fees paid by his class, that a really firm and satisfactory basis for the regulation of a professor's duties can be obtained.

It has been maintained that where an income derived from an endowment of 600*l* can be increased to 1000*l* a year by the receipts from lecture-fees, the professor will be anxious to give such lectures as will attract students—and in spite of objections ready to hand, it is held that those are the lectures which should be given. It is not true that a professor so circumstanced will necessarily degenerate into a mere examination coach If he should be tempted to do so the fault lies with the examination. The professor should himself have a voice in the arrangement of the examination, and care should be taken by the University that it is so organised and defined in all its parts that students who have carefully followed a high class of professorial teaching, such as would be offered by a Huxley, a Ludwig, a Bunsen, or a Fischer, should come to the front in it rather than those who have crammed with some newly-fledged classman, or with an experienced "coach" versed in all the artifices of sham knowledge

It appears to be an excellent and necessary provision to which it is to be hoped that the Commissioners will adhere in spite of all opposition, that the professors in each faculty should with other University teachers in the same faculty constitute a council having the power of controlling to some extent the lectures of each individual professor. There is no degradation in this; it is the almost universal custom in existing Universities. The faculty has to provide for the teaching of its proper studies, and naturally must exercise a friendly control over the extent and scope of the courses of instruction offered by its members.

It is owing to the absence of any such control at the present moment that even by those Oxford professors who do lecture, no representative course on *any subject* is ever given. A student in Oxford cannot by any possibility attend a thorough *course* of lectures or laboratory instruction in physiology, nor in zoology, nor in botany, nor in physics, nor in chemistry And yet in the smallest as well as the largest of the often despised "medical schools" of London, a student has provided for him courses of from thirty to a hundred lectures every year in all these subjects, as well as in others, to be attended, of course, in successive sessions The same absence of complete or representative courses of instruction is to be noted at Oxford in other departments, such as philology, archæology, various departments of history, &c

The sole cause of the existence of such complete courses in other institutions than Oxford—over and above the primary one connected with the income from fees—is that the professor has to submit his scheme of lectures for the ensuing session or year in a general way to his colleagues, who would suggest to him a more complete or more representative program, were his proposals considered insufficient, and might take steps to supplement his teaching by the appointment of a supplementary professor (thus diminishing the original professor's income from fees), were he to prove intractable

The keystone of the professorial system, on which all such control and persuasion, co-operation and reciprocal criticism, must rest, is the income from class-fees. In having not only not insisted upon this, but in having actually prohibited the free levying of fees, the Oxford Commissioners have made their scheme for professors absolutely unworkable They have simply played into the hands of those who have at present a most injurious monopoly of the fees paid by students, and who give in return as little and as inadequate teaching as they please, namely, the confederacy of boarding-house keepers known as "college tutors and lecturers"

The proposal that professors should examine their classes and report to the Heads of Colleges as to the performance of each student was characterised by a spirit of petty interference quite unworthy of the large objects placed before the Commissioners, and has very properly been withdrawn Such details, together with some other points, might well have been left by the Commissioners to the Councils of Faculties, which they so wisely intend to bring into existence

It may be urged that if the Commissioners were to confine themselves in these and similar matters to creating the organisation which is terribly needed at Oxford, and of which these Councils of Faculties promise to be the most powerful and important part, they might with very great advantage leave the question of terminal examinations, and the scale of fees to be charged for lectures, &c., to be worked out by the reorganised University itself But instead of prohibiting class-fees they should have strengthened the hands of the professoriate in the competition with the powerful band who are interested in maintaining the disastrous and absurd system of college tuition and tuition fees So long as the undergraduate is forced to pay to college tutors a lump sum of 25*l* a year, he will seek his instruction (whether he finds it or not) from those whom he has been compelled to pay, and not from the professors whom he is not allowed to pay.

It is clear that with the present body of free-holders it was necessary for the Commissioners to insist on the new principle that a professor is not to be free from responsibility (*Lehrfreiheit*, we may observe, does *not* mean "freedom *from* teaching," as some writers who in the daily papers have recently appealed to German precedents almost seem to fancy), but is, on the contrary, to be charged with certain duties and to be responsible in a measure to his brother professors for performing those duties in a satisfactory manner.

ACADEMICUS

THE INTERNATIONAL GEOLOGICAL CONGRESS

THIS Congress is to hold its second session at Bologna, commencing on September 29, 1881, under the presidency of Signor Q. Sella, president of the Accademia dei Lincei of Rome, and under the patronage of His Majesty the King of Italy, who has liberally placed the necessary funds at the disposal of the Italian Committee of Organisation, of which Prof J Capellini of the Bologna Museum is the president, and General Tarannelli of the University of Pavia the secretary

The movement sprang out of a suggestion made at a meeting of the American Association of Science held at Buffalo, New York, August 25, 1876, that an International Geological Congress was advisable, to insure uniformity of methods of representing geological phenomena, and the value of terms Towards this end a committee of organisation was formed, of which Prof. James Hall was president and Dr Sterry Hunt secretary, in which England was represented by Prof. Huxley, and Sweden by Dr. Otto Torell The result of their deliberations was the first session of the Congress held at Paris, in the Palace of the Trocadéro, under the presidency of Prof. Hébert and the patronage of the Minister of Public Instruction. At the Congress, which lasted six days, two International Commissions were appointed, the one to consider geological cartography, with a view of adopting a common system of signs and colours, the other to investigate the possibility of effecting the unification of geological nomenclature and to consider all matters relating to stratigraphical classification and nomenclature, to a certain extent involving an inquiry into the value and significance of petrological and palæontological characters A third Commission, entirely French, was also appointed to report on Bologna, on the rules to be followed in establishing the nomenclature of species in mineralogy and palæontology

M Renevier, general secretary of the first Commission, has just published his second report of progress, and states that advantage was taken of the presence of several members of the Commission during the fiftieth anniversary meeting of the Geological Society of France on April 2, 1880, to hold a meeting of the Commission at which five European countries were represented, under the presidency of M Daubrée, since then, more or less detailed reports from nearly all the committees representing different countries have been received, except from Canada, presided over by Mr Selwyn, and Great Britain by Prof Ramsay In some of these schemes there is a considerable amount of agreement Quaternary deposits being represented by a pale green, Pliocene by pale yellow, Miocene dark yellow or orange, Eocene by bistre, Cretaceous by green, Jurassic by blue, Lias by violet, Trias by burnt sienna, Permian and Carboniferous by dark grey, Devonian by brown, or brown stripes on pink, Crystalline schists by rose carmine, Granite by dark carmine, divisions in the various rocks being expressed by tints of the same colour, or by shading or dotting.

The General Secretary of the Commission for the Unification of Nomenclature is M Dewalque, who reports that this Commission also met at the Paris Geological Society's anniversary, France being represented by M Hébert, Switzerland by Prof A. Favre, and Great Britain by Prof Hughes The latter Commissioner, aided by Prof Prestwich, has now succeeded in organising a British sub-Commission, who have appointed six committees to inquire into groups of formations, and (1) to draw up a list of the names now in use, (2) to ascertain the true significance of such names or terms, giving reference to the authors by whom they were used in the first instance, or subsequently with a modified meaning, (3) to investigate into the synonomy of such names and terms in the first place as regards the British Isles, and afterwards to inquire into their correlation with them in use in other areas, and (4) to offer suggestions for the unification of the nomenclature. As the committees can seldom sit, as their members are scattered, they have been modelled on the principle of the Inquiry Committees of the British Association, and have attached to them one or two "reporters," charged with assimilating the views and facts collected by the Committee. The reporters for the British Isles, are for Recent and Tertiary rocks, Messrs. Starkie Gardner and H B. Woodward; for Cretaceous rocks Messrs. Topley and Jukes-Browne, for Jurassic rocks Messrs. Huddlestone and Blake; for Trias and Permian, Mr. De Rance and the Rev. A. Irving; for

Carboniferous, Devonian, and Old Red, Messrs Morton and Strahan, for Silurian, Cambrian, and Pre-Cambrian, Messrs Lapworth and Marr. For chemical, dynamical geology, petrology, and mineral veins Messrs Bauerman and T. Davies.

The last-mentioned committee is specially to consider the question of nomenclature under the following general heads. (1) Terms founded on physical characters, (2) founded on mineral composition, (3) founded on names of places; (4) founded on local peculiarities and common usage, (5) founded on theories of origin and other hypotheses; (6) synonyms, (7) suggestions for systematising and for unification of nomenclature.

The Sub-commission or General Committee has Prof Hughes for its chairman, and Mr E. B Tawney for its secretary; its duty is to receive the reports of the Committees and to consider the value of terms. The list of names forming the Sub-Commission includes those of Mr. Etheridge, P G.S, Professors Bonney, Boyd Dawkins, Haughton, Hull, Judd, Lebour, Morris, Prestwich, Rupert Jones, and Seeley, Doctors Clement Le Neve Foster, Evans, Geikie, J. Geikie, Hicks, Nicholson, and Sorby, and the names already mentioned, of members acting as Reporters, Secretary, and the Chairman The Sub-Commission consider that the word *system* should be used as the term indicating the largest sub-division, applied to a group which stands by itself, easily and clearly distinguishable from the rocks above and the rocks below, bounded above and below by triads in stratigraphical regions, and characterised by special forms of life *Formation* expresses a smaller group, with some lithological and palæontological characters in common, but which may be in continuous sequence with the rocks above and below. *Deposit* implies similarity of lithological character. *Layers*, *laminæ*, *bed*, *group*, *series*, and *rock* are still under discussion *Zone* and *horizon* were defined, but *cycle* and *data* were left open questions

Through the liberality of His Majesty the King of Italy, the committee of organisation are able to offer a prize of 5000 francs for the best suggestion for an international scale of colours and conventional signs practically applicable to geological maps and sections, including those of small scale The index of colours and signs should be accompanied by maps representing regions of varied geological structure, and by an explanatory memoir in the French language The documents should be marked with a motto, which should be placed on the outside of an envelope containing the name of the author, which will not be opened until the Congress, when the name of the successful competitor will be made known The index and accompanying papers should be sent in to Prof. J. Capellini, director of the Museum at Bologna, by the end of May. The award will be made by a jury of five chosen from the presidents of sub-commissions. Should no index be thought worthy of the grand prize, the best will receive a gold medal of the value of 1000 francs, while to the two next will be given medals of silver and bronze of similar shape. C. E DE RANCE

THE FALLS OF NIAGARA IN WINTER

IN the first week of last February it fell to my lot to make very hurriedly the transcontinental journey of 3500 miles from San Francisco to New York. Before starting I resolved that the one stoppage which I could allow myself *en route* should be made at Niagara. I had visited the Falls in the early summer of 1879, and was so profoundly impressed by them that I could not resist the opportunity of seeing them again under their wintry aspect, and I was confirmed in my resolve by seeing statements in various American papers to the effect that, owing to the long-continued and exceptionally severe cold of the present winter, the Ice-mountains at the Falls were higher than had ever been previously known. These statements were confirmed to me on the spot by several persons long resident in the village.

Two or three preliminary notes on the journey across the Rocky Mountains in midwinter may not be without interest for the readers of NATURE I left San Francisco on February 2nd in the midst of most serious floods, and on that particular day they attained their maximum, which was one inch higher than any previously recorded It was estimated that 3500 square miles of the most fertile land of California was under water, and in many parts steamboats of light draught were plying over the country. Any assessment of damage would have to be made by millions of dollars. I heard many and grievous complaints of the damage done to the agricultural interests of the country by the "hydraulic mining," which washed the hillsides down into the river beds, filling them up, and thus prevented much flood-water from being carried off In some places the railroad track had been apparently washed away, for it could not be found, and from this cause our journey to Sacramento was lengthened about fifty miles, as the gigantic ferry-boat *Solano* could not be used for the short route This boat has four tracks upon it, and will carry twenty-four cars. As each car seats fifty people, this is equal to carrying a train that will accommodate 1200 people It has four side-wheels, each with its engine and set of boilers In crossing the Sierras we encountered little snow, but a great deal of rain. The greatest amount of snow on the journey was in the upper part of the Weber Cañon, 100 miles east of Ogden and Salt Lake Here there had been considerable difficulty in keeping the line open during January, but the train-service had not been interrupted for a single day, although the snow-sheds and snow-ploughs were constantly required That the weather had been unusually severe was shown by the very large number of dead cattle along the line, from Ogden across the Laramie plains, and also, I was informed, in Colorado In the four days between San Francisco and Omaha (where we arrived punctually), the terminus of the Pacific Railroad, the temperature was never below 26° F, and the air so still that I frequently saw smoke rings from the locomotive funnel expand to 6 or even 8 feet diameter, rising perhaps 30 or 40 feet in doing so. All the cars were warmed, usually to too great an extent, from 70° to 75° F, being the normal temperature for the interior of railway cars, hotels, private houses, and schools, as far as my experience went.

East of the Missouri (which, like all the rivers I crossed, was frozen over) trains were everywhere very much delayed, owing to snowstorms, or to the slippery state of the rails, which were coated with ice. The utmost caution was used by those in charge of trains, and a strong impression was left on my mind that safety, and not speed or punctuality, was the primary consideration in such American railway management as I came across.

On leaving Chicago a phenomenon presented itself which is common enough in America, though but rarely seen in this country, and never on so gigantic a scale For several days the temperature had been very low, and every object was exceedingly cold. On the night of February 6th, the air-temperature rose to 33° F, and fine rain fell. This froze upon everything and encased it with transparent ice, from which in many instances delicate icicles depended Sad havoc was played with the overhead telegraph wires in Chicago itself (which were broken by the weight), but on leaving the city in the early morning the exceeding beauty of the whole country, usually so uninteresting from its flatness, became apparent. A light coating of snow lay on the ground, but everything, every twig, every dead leaf, every blade of grass, had its own transparent covering, which in the occasional gleams of the sun shone with the most gorgeous colours.

For seven or eight hours we travelled through this, a distance of some 250 miles, and I heard of similar and simultaneous appearances over larger tracts of country.

Gigantic icicle under Table Rock, photographed in January, 1881. The upper right-hand corner is rock and a portion of the Canadian (or Horse-Shoe) Fall is seen on the left. The whole of the apparent ground is a mass of frozen spray which has accumulated many feet in thickness on the shingle, &c., at the foot of the rock.

Probably the most wonderful exhibition ever seen, of, not frozen rain, but frozen spray, was to be found at the Falls of Niagara. A large number of readers of NATURE have visited them, and possibly all are sufficiently familiar

with their topography, through the medium of books and photographs, to render any general description unnecessary. I will therefore confine myself to the special features produced by this winter's cold.

The whole district lay under a thin coating of snow, and all the roads were in good condition for sleighing, indeed those near the Falls were so completely ice-covered with frozen spray, as to render no other mode of locomotion possible. Those who have seen both places have probably been struck, as I was, with the strong resemblance between the gorge of the Niagara river below the Falls, and the gorge of the Avon at Clifton, Bristol The latter is the finer of the two, being narrower, and having higher sides, but both are limestone gorges, and similar in character. In the Niagara gorge numerous springs discharge themselves into the chasm at various points in the precipitous rocky sides, and at these points numerous collections of huge and massive icicles appeared as though adherent to the rock, measuring perhaps seventy or eighty feet in length, and eight to ten feet in irregular diameter. In the exquisite purity of their colour and general appearance, they reminded me strongly of the pillars of ice in the upper part of the Rhone glacier.

The width of the river itself was not a little lessened, both in the rapids above and the comparatively still water below the Falls, by the ice at the banks, and it was a matter of surprise to notice how much ice accumulated at the edges of water that was running very rapidly. At the top of the American Fall itself there were so many accumulations of ice that the Fall was actually divided into five separate and distinct Falls, in the same way as, even in summer, that portion of the Fall which is in front of the "Cave of the Winds" is cut off by rocks on the upper edge, from the main body of the Fall

The mention of the "Cave of the Winds" recalls also that huge boulder, the "Rock of Ages," in front of this portion of the Fall. That however is only one of many others in front of the American Fall, and these boulders are, as it were, gigantic nuclei, round which the frozen spray accumulates, and produces the Ice-mountain of which we hear so much, and the remains of which are not unfrequently to be seen even by summer visitors. The average height of this is about half the total height of the Fall, but this winter it has attained to the unprecedented height of within twenty feet of the top of the Fall! This highest point is at about one-third of the total width of the Fall, measuring from Goat Island. Between the foot of the incline from Prospect Park and the edge of the Fall is another very high mass The ice approaches very close to the front of the Fall, and the whole basin into which the water descends is thus closely surrounded, and partially covered, with an enormous and irregular mass of pure semi-transparent ice, of (on the day of my visit) the most beautiful emerald green hue! Later in the day I had the good fortune to fall in with Mr. Bradford, the artist who is so well known for his pictures of Greenland scenery, and in discussing the ice cones formed at waterfalls, he mentioned that, having passed a winter in the Yo Semité valley in California, he had seen an ice-cone close to one of the celebrated Falls there, which was at least 600 feet in height.

Within the last few years a considerable portion of "Table Rock" has fallen away. In its present condition a stream of water about one foot in thickness falls over it in summer, and, owing to the amount of its overhanging, it is easy to get between this Fall and the rock, and thus to be "behind Niagara" At the time of my visit (February 8th), however, the whole of this portion of the Fall was *completely frost-bound*. Enormous icicles, of the most surpassing beauty, depended from the rock above, while at my feet were masses of the frozen spray from the Horseshoe Fall. The intense emerald green of the water of that Fall, seen through and between these magnificent ice-pendants, could be reproduced by no artist, but will never be effaced from my memory The accompanying woodcut, photographed on to the wood block from a photographic picture taken a few days prior to my visit, will, to those who know the place, give some faint idea of the beauty of the scene, and of the gigantic scale of the icicles. It is scarcely necessary to say, perhaps, that the circular wooden staircase by which the descent under Table Rock is effected, was covered with many feet thickness of ice on the side next the Fall. As the air-temperature was slightly above 32° F and the icicles were occasionally falling around us, my guide was unwilling that I should remain long, or make any attempt to measure any of the ice-masses.

The fourth, and to the casual visitor perhaps the most remarkable effect of the cold in the immediate neighbourhood of the Falls, is the manner in which every surrounding object is coated with an immense thickness of frozen spray The trees on Goat Island and in Prospect Park are thus covered to a slight extent, and present a very beautiful appearance The strangest examples, however, occur on the Canadian side, close to the Horseshoe Fall, where huge irregularly-shaped masses of ice are seen, some of which resemble, in general form, merely a colossal bunch of grapes standing erect on its stalk. A little investigation shows that these are trees, staggering under the weight of tons of ice Not unnaturally they have many broken branches, and have almost invariably lost their tips In one instance which I saw, and of which I obtained a photograph, the spray had so accumulated in front of the trunk of a tree about nine inches in diameter, that it had formed a wall of ice *five feet* in width, and of the same thickness as the diameter of the tree-trunk A flagstaff planted on Table Rock had four or five projections from its top, varying from three to five feet long, and looking like "frozen streamers," or as though watery flags had been flying, and had suddenly been frozen. These were so inaccessible and so dangerous to the passer-by, that they were daily shot down with rifle-bullets! The museum with its pagoda and the adjoining houses close to the Horseshoe Fall were cased with sheet-ice and pendant icicles to such an extent that much of the frozen spray had to be removed daily with an axe

I mounted to the pagoda (well remembered, I have no doubt, by summer tourists) and there I listened to the "Music of Niagara," of which Mr Eugene Schuyler has given in the February number of *Scribner's Magazine* an account so interesting, that I venture to conclude this article with a short abstract of it.

Mr. Schuyler starts with the statement that "the tone of Niagara was like that of the full tone of a great organ. So literally is this true that I cannot make my meanings clear without a brief outline of the construction of that great instrument." He then explains the mutual relation of the various pipes, the "ground-tone, over-tones or harmonics, and under-tones or sub-harmonics," and relates his experiences in the Cave of the Winds, on Luna Island above the Central Fall, at the Horseshoe Fall among the rapids, and at the Three Sister Islands. "In fact, wherever I was, I *could not* hear anything else! There was no *roar* at all, but the same great diapason—the noblest and completest one on earth!" Further details of visits to various points are given, and it is interesting to notice that although previously unacquainted with the difference in height of the two Falls, Mr Schuyler unhesitatingly pronounced the Horseshoe Fall to be several feet lower than the other, guided solely by his musical ear. He then proceeds thus:—

"Now, what is this wonderful tone of Niagara? or rather, what are all these complex tones which make up the music of Niagara? With more or less variation of pitch at various points (to be accounted for), here are the notes which I heard everywhere:—

Just these tones, but *four octaves lower!*

"At once it will be incredulously replied, 'No human ear ever has heard, or ever can hear, tones at such a depth' I arrived at my conclusions both theoretically and practically, and the two results coincided exactly" For the explanation of this, those interested will do well to consult the article itself It may be noted here, however, that notes 3 and 4 were heard *everywhere*, that the 5th and 6th were perfectly distinct, but of far less power, that the 7th (the interval of the tenth) was of a power and clearness entirely out of proportion to the harmonics as usually heard in the organ, &c., and that the 8th, 9th, and 10th notes were only heard occasionally and with a transient impression Mr Schuyler then points out that, allowing for the fact that the diameter of Niagara is the *greatest* possible compared with its height, the length of an organ-pipe necessary to give the key-note of Niagara (four octaves below note 1 in the diagram) would be just the average height of the Falls! The figures given are 170·66 feet − 10·24 feet = 160·42 feet, where the 10·24 feet is the allowance for the extra diameter of Niagara treated as an organ-pipe.

It appears, then, that the tone of Niagara is, *note for note*, the dominant chord of our natural scale in music Its rhythm is one note per second, with three notes in each measure, the first note being the accented one, and the single beats are represented by groups of three semiquavers, where M M 60 = ♩, or three times three, three times repeated.

Mr. Schuyler thus concludes in words with which I heartily sympathise. "I have spoken only of the pitch and rhythm of Niagara. What is the *quality* of its tone? Divine! There is no other word for a tone made and fashioned by the Infinite God I repeat, there is no *roar* at all—it is the sublimest music on earth!"

WILLIAM LANT CARPENTER

ZOOLOGICAL RESULTS OF THE VISIT OF PROF. K. MOEBIUS TO MAURITIUS[1]

THIS work, which is illustrated by a map and twenty-two plates, contains the results of the investigations of Prof Mobius on the marine fauna of Mauritius and the Seychelle Islands, embodying the account of observations made by him on the spot, and of work done on the collections which he brought home with him on his return from his visit to the islands. It commences with an account of the journey to Mauritius in 1874-75, an account of the Suez Canal is given, and of the voyage through the Red Sea, where Trichodesmium, the yellowish-red floating algæ supposed by some to have given the name to the sea, was met with in abundance After the well-known tanks of Aden and the Somali divers who surround every ship that comes into the port have been described, Réunion is touched at, and at last Mauritius.

A concise account is given of the geographical, geological, and climatic peculiarities of this island, which is about one-third the size of Holstein. The centre of the island is occupied by a plateau elevated over 1700 feet above sea-level, the highest point being 2711 feet in height. The plateau is surrounded on nearly all sides by mountains, and from these on all sides but the northern, where there is a gradual inclination, rivers and streams fall down very steep slopes with frequent waterfalls into the sea. Rains are very heavy, and the mountain torrents swell with remarkable rapidity. The geological structure of the island is entirely volcanic, with the exception of beds of coral rock The mean temperature of the year is about 25°85 C Rain is most abundant from December to May The prevailing wind is the south-east trade Cyclones are sometimes experienced in the period, December to April, but do not occur every year.

Mauritius had originally no mammalian inhabitants excepting bats The great fruit-bat (*Pteropus vulgaris*) is abundant in the woods These fruit-bats are easily tamed One of them was a great pet of Mr G. Clark, now dead, who was the author of "A Brief Notice of the Fauna of the Mauritius," published in the *Mauritius Almanac* for 1859, and containing some very good observations This tame bat was taken when young from its mother's breast and brought up by hand. It could not fly, because its wing membranes had been cut through to prevent its doing so It usually passed its time hanging on to the back of a chair Directly Mr Clark came into the room it cried out loudly to be nursed If it were not taken up at once it climbed up to him, rubbed its head against him, and licked his hands If Mr Clark sat down the bat hung on at once to the back of the chair, and followed all the movements of its master with its bright eyes If its master caught hold of a fruit it climbed forthwith down his arm to his hand to get its share, and it always got two teaspoonsful out of every cup of tea or coffee. If Mr Clark took any kind of object in his hand the bat climbed to it, examined it with its eyes and nose, and only returned to its chair-back after completely satisfying its curiosity. It followed its master even into the open air if the door was not shut to prevent its getting out

A good many mammals have been introduced into the island, and are now abundant A monkey from the East Indies (*Macacus cynomolgus*) inhabits the woods, and makes excursions from thence to plunder the sugar-cane fields One of the species of the curious hedgehog-like insectivora of Madagascar (*Centetes ecaudatus*) was introduced in the island at the end of the last century. The animals live in damp places and lie in a state of sleep (= hybernation) in the dry season, sleeping then so soundly that they do not awake even when dug up As soon as the rainy season begins in November they wake up and breed, producing three litters of fifteen or sixteen young every year The young follow the mother, who calls them with a grunting noise, in a row behind, and protects them when molested with her teeth and spines. A full-grown male weighs as much as four pounds. The animals are so abundant that on a moonlight night with trained dogs twenty or thirty may be caught by one hunter They are eaten by the working classes.

Besides these there is a shrew mouse, also introduced from the East Indies, a small hare, and the ubiquitous common rat, both of which latter gnaw and destroy the sugar-cane A stag (*Cervus hippelaphas*) introduced by the Portuguese inhabits the woods. It breeds in July and August, and casts its horns in December or January.

We cannot follow the author in his short reference to the birds and account of the fish. The coral-reefs of the island appear to abound with animal life of all kinds. Several of the corals composing them are laid dry constantly at low tide, and remain exposed to the air without injury. *Goniastræa retiformis* and *Leptoria gracilis* are cited as examples of such Whilst these corals are in this condition, the polyps remain entirely withdrawn, and the whole surface of the coral laid bare is covered with slime, which prevents its drying up.

In the Seychelles, of which a short account is given, the giant turtle (*Chelone virgata*) is kept in ponds as at Ascension, and is caught with a rope round the flipper, and dragged out to be slaughtered when convenient. The

[1] Beiträge zur Meeresfauna der Insel Mauritius und der Seychellen, bearbeitet von K Möbius, F. Richter und E. von Martens, u.s w. (Berlin Otto Enslin. 1880)

author here dug up a Cæcilian (*Cæcilia virgata*), and amused himself with the curious leaf insect (*Phyllium siccifolium*)

The Introduction to the book is followed by a long paper by Prof Mobius on the Foraminifera of the Mauritius, illustrated by many finely-executed plates Amongst other Rhizopods a Haliphysema occurs, the animal which, by a most extraordinary blunder, was made out by Hackel to have a multicellular structure, and supposed to represent a Gastræa of modern times Prof Mobius confirms the observations of Carter, Savile Kent, and Ray Lankester, to the effect that the animal is in reality simply a Rhizopod He has examined the structure of the Foraminiferous shells which he describes, very carefully by means of sections He does not, however, add anything of importance to our knowledge of the structure of the soft tissues of the group.

An account of the Decapod Crustacea by Dr. F Richter follows that of the Foraminifera Two crabs of most extraordinary habits are described in this portion of the work. Both belong to the family Polydectinæ The crabs of this family have their front claws armed with large teeth Latreille, who first named the crab *Polydectes cupulifer*, remarked that a gummy substance was always to be found at the ends of the claws of this species, and Dana described the animal as having always something spongy in its hands Dr Mobius has discovered the remarkable fact that these things held in the two claws of the crab are in reality living sea-anemonies These sea-anemonies are attached to the immovable joint of each claw, whilst the teeth of the movable joint of the claw are kept buried deep into the flesh of the sea-anemonies, and thus hold them fast, although each anemony can easily be pulled away from its position with the forceps in specimens preserved in spirits The mouth of the sea-anemony is always turned away from the crab The same curious combination exists in the case of another species of the same family but of a different genus, *Melia tessellata*, which also inhabits Mauritius A figure is given of this crab with its pair of Actinias, named by Mobius *A prehensa*, with fully expanded tentacles, held out one in each hand Mobius gives the following account of the matter "I collected about fifty male and female specimens of *Melia tessellata*, all of these held in each claw an *Actinia prehensa*. The recurved hooks of the inner margins of the claw joints of the crab are particularly well adapted to hold the Actinias fast I never succeeded in dragging the living Actinias out without injuring them. If I left the fragments of them when pulled out lying in the vessel in which the *Melia* was, the crab collected them again into its clutch in a short time If I cut the Actinias in pieces with the scissors, I found them all again in the claws of the crab after a few hours It is very probable that the Actinias aid the crab in catching its prey by means of their thread-cells, and that the Actinias, on the other hand, gain by being carried from place to place by the crab, and thus brought into contact with more animals which can serve as food to them, than they would if stationary. This is a very interesting case of commensalism"

The work closes with a long account of the Mollusca of Mauritius and the Seychelles by Prof E von Martens.

H. N. MOSELEY

NOTES

THE centenary of the birth of George Stephenson is not to be allowed to pass by in a fruitless way in Newcastle-upon Tyne Dinners, speeches, trade processions, enthusiasm and bunting—all this was to be expected in a place so intimately connected with the birth of railways. But more than this will probably be done, and we are glad to hear that a scheme is on foot for commemorating the 9th of June in a more useful and more lasting manner, viz. by providing a "Stephenson College" for the use of the houseless but hard-working College of Physical Science of the University of Durham in Newcastle.

THE French Association for the Advancement of Science has been in existence only ten years, but in that short time it has met with astonishing success, and has done some excellent work. To the fifteen sections already existing it proposes to add a sixteenth, under the name of the Section of Pedagogy, and a committee of members will discuss its formation at the forthcoming meeting at Algiers The subjects of which the Association takes cognisance are divided into four groups, viz, Mathematical Sciences, Physical and Chemical Sciences, Natural Sciences, and Economic Sciences. A goodly list of papers has been already announced, among the authors of which we notice some of the most prominent *savans* in France. We trust, however, that the Association will not degenerate into a great excursion organisation, as to some extent it appears to have done this year Thus the meeting lasts for six days, while the return tickets, issued in connection with the Association under very liberal terms, are good for six weeks, and no less than fifteen excursions in the neighbourhood of Algiers have been arranged Five of these each occupy a week, and one of them a fortnight The great number of applications for tickets both from France and Spain compel us to imagine that in many cases the membership of the Society has been sought this year rather for the sake of the tempting excursions than for the love of science April is one of the most lovely months in the year at Algiers. the mean temperature is 16 5° C, with a possible minimum of 8°, and a possible maximum of 30°. In May the mean temperature is 19 5° C, and there may be eight days of rain, while at Biskra the maximum may be as high as 40° C (104° F), and not more than one day of rain may be expected in May A proclamation has been issued by the local committee asking the inhabitants to place rooms at the disposal of the visitors. Among those who will cross the Mediterranean will be Admiral Mouchez, MM Quatrefages, Wurtz, Saporta, the naturalist, M Cartailhac, the geologist, and many others, who will give interesting papers on a variety of subjects.

MR ASHTON DILKE tried in vain on Tuesday to get the House of Commons seriously to consider the advisability of adopting the decimal system of coinage in this country. It is hopeless in the present state of public affairs to induce Parliament to attend to a matter of this kind On the widely beneficial results of the adoption of the metric system in whole or in part we have often insisted That there would be some inconvenience in making the transition, of course every one will admit, but as compared to the ultimate benefits from the adoption of the metric system, they are not worthy of consideration. Mr. Dilke does well not to let the matter drop out entirely of public notice.

THE Thore prize of the Académie des Sciences of Paris has been awarded to M. A. Vayssiere, préparateur des cours de Zoologie à la Faculté des Sciences de Marseille, for an anatomical memoir of *Prosopistoma punctifrons*, Lat. Some of our readers interested in comparative anatomy may remember having seen the original drawings in London last summer, and will be glad to know that it will soon be forthcoming. M. Vayssière is a careful expert.

THE French Minister of Public Instruction intends to do a great service to science by publishing monthly a *résumé* of the scientific work being done over France, under the title of *Revue des Sciences*. The review will be under the direction of the venerable M. H Milne-Edwards, and will consist exclusively of analyses and summaries, but of sufficient detail to give a fair idea of the nature of the work being done. It will embrace the work of individuals and of societies all over the country, and each number will contain about 100 pages.

M. DELESSE, a member of the Institute, vice-president of the Geographical Society of Paris, and author of a number of works and papers on geology, died in Paris at the age of sixty-three years.

THE death is announced on the 25th inst. of Sir Charles Reed, M.P., the much-respected chairman of the London School Board.

A METEOROLOGICAL observatory has been erected at Port-au-Prince, Haiti, under the care of the Rev. Father Wiek, on ground granted by the State It is an octagon of two stories and a platform Besides the indispensable instruments it has electric clocks (for communicating the time to clocks outside), telephones, microphones, phonographs, radiometers, &c

THE inaugural meeting of a Society of Chemical Industry will be held in the rooms of the Chemical Society, Burlington House, Piccadilly, on April 4, at 4 p.m This Society is not intended to represent any one particular branch of chemical industry It is hoped that it will be representative of many manufactures—alkali-making, manure-making, the textile colour industries, the glass and pottery manufactures, tar distilling, soap-making, sugar-making, brewing, metallurgy, the manufacture of fine chemicals, and all other industries which show any connection with chemical science

THE newly-issued part of the *Medical Reports* which are from time to time issued by order of the Inspector-General of Chinese Maritime Customs, contains an elaborate monograph by Dr Duane B Simmons on the subject of Beriberi, or the Kakké of Japan, which includes some interesting notes on the history and geographical distribution of the disease, and is illustrated by a sketch-map.

MR. BOWDLER SHARPE, F L.S., delivered on Thursday last the concluding lecture of a series on the "Birds of the World," which he has been giving at Tonbridge School. Throughout the winter lectures have been given on various literary and scientific subjects by Prof. Henry Morley, Rev. A Lucas, and others, and large and attentive audiences have shown great interest in all the series. The school already possesses a small museum, which is increasing under the auspices of the present head-master, the Rev T. B Rowe, who is evidently doing his best to encourage a taste for science and literature in the institution under his charge

EVERY ornithologist should read a little pamphlet recently sent to us by the Dundee Naturalists' Society, entitled "The Grallatores and Natatores of the Estuary of the Tay; the great decrease in their numbers of late years, the causes; with suggestions for its mitigation. A paper read by Col. Drummond Hay." The author, whose long residence in the district alluded to renders his experiences doubly interesting, makes out a good case for his friends the birds in regard to their alleged destruction of fish and spawn, and no doubt some notice will be taken of his statements at the approaching Fisheries' Exhibition at Norwich. The principal cause in the decrease of the birds on the Tay he attributes chiefly to the increased number of gunners on the river, who disregard the close-season, while the wilful destruction of the sea-birds' eggs also plays sad havoc amongst their numbers. Drainage and cultivation of the land has also altered the conditions under which certain species nested, and has driven them further afield.

A Conference on the reform of the Educational Code is to meet in London in the third week in April, and to sit for two days, for the purpose of drawing up a series of recommendations, to be submitted in the form of a memorial to the Vice-President of the Committee of Council. The gentlemen invited to attend are persons conversant with the practical working of the public elementary school system, head-masters of secondary schools, persons experienced in education, and others interested. Invitations have been accepted by the chairmen of the Education and School Management Committees of the School Boards for London, Liverpool, Birmingham, Leeds, Sheffield, Bristol, Bradford, Leicester, and Nottingham, also by Dr. Abbott, Dr Caldicott, Mr. Eve, Professors Max Müller, Carey Foster, Henrici, Gladstone, and Meiklejohn; Sir U. Kay-Shuttleworth, Sir. John Lubbock, the Rev Mark Pattison, and numerous others

MR STEPHEN BRETTON, F M S., writes from Eastbourne to the *Times*, under date March 28, that he saw a meteor of great splendour that morning (1.15 a.m. Greenwich mean time), the finest he ever observed. Its size was apparently rather larger than Venus at her brightest, and for two or three seconds illuminated the heavens very brilliantly. Its colour was of an intense purple white, and moved somewhat slowly. He first noticed it a little south of Regulus, and going in direction of Castor. When immediately below Præsepe it burst into about five or six fragments, each about the size of a star of the third or fourth magnitude, these assuming a deep fiery red It then immediately disappeared. The night was especially clear; temperature in air about 30°; barometer about 29 850.

THE Committee of the "Frank Buckland Memorial Fund" have decided that the memorial shall take the form of a bust to be placed in the Fish Museum at South Kensington, the purchase of an annuity to be presented to Mrs Buckland; and, if there be any surplus, it will be applied in some way to promote the welfare of the fishermen of this country. The honorary secretaries are Col. Bridges and Mr. T Douglas Murray, to whom subscriptions may be sent at 34, Portland Place

SMART shocks of earthquake occurred at Agram on March 21 at 3h. 40m a.m, duration three seconds, and on March 24 at 6h 45m. a m., both accompanied by loud subterranean noises.

THERE was another earthquake shock at Casamicciola on Sunday morning at 6 45.

M. VAN MALDEREN, who was the electrical engineer of the Alliance, and constructed the so long unrivalled magneto-electric machine belonging to this Company, died at Brussels at the age of seventy a few days ago.

ALL the obstacles which have prevented the reconstruction of the Sorbonne being accomplished, have been removed by M. Jules Ferry, and the work will begin immediately. The same may be said of the isolation of the Public Library of Paris, all the required expropriations having been decreed.

THE date for admission of exhibits to the International Exhibition of Electricity at Paris has been prolonged to April 15.

THE Geologists' Association Easter Excursion will be on Monday and Tuesday, April 18 and 19, to Salisbury, Stonehenge, and Vale of Wardour.

COLONEL PARIS, the head of the Paris fire brigade, has concluded his report on the destruction of the Printemps Establishment by proposing that large warehouses be compelled to light by electricity The burning of the Nice Theatre, which was occasioned by a gas explosion, has given a new importance to that movement.

M. DE MERITENS has completed the construction of one of his magneto-electric engines intended for lighthouse illumination. An experimental trial took place on March 25 before MM. Becquerel, Cornu, Mascart, and other members of the Technical Commission of the International Exhibition. It was proved that with fifteen horse-power his machine illuminates at once more than thirty Jablochkoff lights, and that it could, at a moment's notice, be used as a regulator for marine purposes.

MR. THOMAS EDWARD, the Banff naturalist, has reprinted in a separate form some useful and interesting papers on the Protection of Wild Birds. The pamphlet is to be had at the *Banffshire Journal* Office.

THE additions to the Zoological Society's Gardens during the past week include an Egyptian Gazelle (*Gazella dorcas*) from Egypt, presented by the Earl of March, F Z S ; a Common Genet (*Genetta vulgaris*), South European, presented by the Rev F P Voules, a Giant Toad (*Bufo agua*) from Brazil, presented by Mr. Carl Hagenbeck, a Long-snouted Snake (*Passerita mycterizans*) from India, presented by Mr. H H Black, an Amherst's Pheasant (*Thaumalea amherstiæ*) from Szechuen, China, a Black Swan (*Cygnus atratus*) from Australia, purchased, a Tiger (*Felis tigris*), a Bactrian Camel (*Camelus bactrianus*), a Sambur Deer (*Cervus aristotelis*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

A NEW VARIABLE STAR.—On July 26, 27, and 29, 1783, D'Agelet observed a star which he twice estimated 6m, and on the last night 6 5m., it is No 5057-9 in Gould's reduced catalogue, the mean of the three observations giving for 1800, R.A 19h 23m 47·57s and Decl. + 17° 19′ 42″ 8. The only subsequent observation we have yet found of this star is in the *Durchmusterung*, where it is rated as low as 9 4m ; there is consequently a high probability that it will prove to be a remarkable variable. The position brought up to the beginning of 1880 will be R A. 19h. 27m 22·1s, Decl. + 17° 29′ 28″. D'Agelet's original observations will be found at pp 542, 544, and 546 of the *Histoire Céleste* of Lalande

MINIMA OF ALGOL, ETC, IN 1880.—Prof. Julius Schmidt has published his observations, or rather the results of his observations, of Algol and other variable stars, made at Athens during the past year. On comparing his epochs of minima with the formula in Prof. Schonfeld's last catalogue, it will be found that according to the most completely determined minima the calculation is too late by nearly half an hour But the differences between calculation and observation are very irregular, so that if we take a mean of the whole, the true minimum would appear to be earlier than that computed by only nineteen minutes. The minima between August 28 and December 21 are here compared.

According to the observations of the same indefatigable astronomer *Mira Ceti* was at a maximum between July 20 and 25, but in 1880 it only attained about 4 2 m A maximum of R Leporis occurred about November 9; the determination is not very certain. The intervals between maximum and minimum, and *vice versâ* of α Herculis were as irregular as usual.

THE RED SPOT UPON JUPITER'S DISK.—Dr Jedrzejewicz has published some inferences from observations for ascertaining the time of rotation of the eastern extremity of the large red spot upon the disk of Jupiter, made at his private observatory at Plonsk during the winter of 1880-81. The instrument employed is a refractor six-inches aperture, with powers 225 to 300 In December he measured the length of the spot 9″·8, and considers that his own observations compared with those of Prof. Schmidt at Athens, indicate that the length of the spot remained unchanged during the winter. On this assumption he finds for the time of rotation 9h. 55m. 34·414s. ± 0·13s, by 174 rotations between November 25, 1880, and February 5, 1881. Prof. Schmidt from 1021 rotations between July 23, 1879, and September 17, 1880, obtained the value 9h. 55m. 34·422s. ± 0 05s for the middle of the spot. In 1862, by observations upon a spot which he says was much darker and a more favourable object for the purpose than the spots observed by Airy and Mædler in 1834-35, and which was not much larger than the shadow of the third satellite he had found for the time of rotation 9h. 55m. 25·684s. agreeing with the previously-determined values While the period from observations of the red spot is 9s. greater, Prof. Schmidt remarks that it agrees very nearly with that already obtained by Mr. Pratt.

THE MINOR PLANETS.—It appears that the object detected by Herr Palisa at the new Observatory of Vienna on the 23rd of last month, and which was announced as No 220 of the small-planet group, may prove to be No. 139 *Juewa*, which had not been observed since 1874. It was discovered by the late Prof. Watson at Pekin on October 10 in that year, while he was engaged upon one of the United States expeditions for the observation of the transit of Venus, and as was reported at the time, without the aid of a chart of telescopic stars, but from his memory of their configuration about the particular spot occupied by the planet. It was observed on November 8 by Rumker at Hamburg, but the length of observation was not sufficient to determine the mean motion with any degree of accuracy · hence although the elements had been several times brought up to more recent dates by Watson, the planet had not been recovered up to last month

By the last Berlin circular it would seem that *Ismene* will fall little short of *Hilda* in the length of its revolution, and these two minors will thus stand out as exceptional members of the group By the latest elements the period of *Hilda* is 2860 days or 7 832 years, and that of *Ismene* 2854 days or 7 814 years.

Calculation has assigned the shortest period to No. 149 *Medusa*, but this awaits confirmation, perhaps in the next summer, when the planet should again come into opposition according to the imperfect elements at present available

PHYSICAL NOTES

M PLANTAMOUR continues to study with his sensitive levels the phenomena of periodic rise and fall of the ground which he has observed in Switzerland. He believes he has established a connection between these periods and those of the changes of temperature of the earth's surface, there being an annual change of level in an east-west direction corresponding with the mean temperatures of the surface during the year

M ROSENSTIEHL concludes from his researches on the sensations of colour recently noticed that the three fundamental colour sensations of the Young-Helmholtz-Maxwell theory correspond to the following tints of the pure spectrum. *Orange-red*, three-fourths of the distance from C to D amongst the Fraunhofer lines, a *yellow-green* three-quarters of the distance from D to E, and a *blue* situated at one-third from F towards G. The principle upon which this selection is made is that the selected tint fulfils the following conditions (*a*) it is equidistant between two tints which are complementary to one another; (*b*) it produces with either of the other selected tints another colour having a minimum of white admixed with it Thus the yellow-green chosen is midway between that yellow and that blue which produce the best white with one another, and it gives with the selected orange-red a yellow more intense than any known yellow pigment under equal illumination, and with the selected blue gives a green more intense than the richest green pigment

M. HENRI BECQUEREL observes that the specific magnetism of ozone exceeds that of oxygen, and is much greater than could be accounted for by the difference in density of these two allotropic forms of the gas

IN view of recent terrible colliery explosions in Belgium, M. Cornet has called attention (in the Belgian Academy) to a possible interference of winds, blowing in an inclined direction, with the proper ventilation of mines Most of the "fiery" Belgian mines have two shafts, one for raising the coal and for descent of air, which, passing along the galleries, is drawn up the other shaft by a ventilating engine The orifice of the latter shaft is generally (unlike that of the other) unsheltered by buildings; it debouches directly in the air a little above the ground. Obviously, then, a strong wind, blowing with downward inclination towards this orifice, might seriously affect the ventilating action. It is noted that one explosion in Hainaut on November 19, 1880, followed a night of very high wind, which M. Cornet shows to have been capable of depressing ventilation considerably Mines with large sections are more dangerous than others in atmospheric perturbations. The true remedy, however (in the author's opinion), is not increasing the resistance to the air-currents, but sheltering the orifices of the ventilating shafts against descending winds.

IN a recent paper on the optical structure of ice (to the Freiburg Society of Naturalists) Prof. Klocke finds that while in the ice individuals the plane of the secondary axes is fixed by the position of the principal axis, they are subject to no law as to direction in that plane

THE phenomenon of *verglas* occurred at Urbino in Italy twice in January, and from his observations of it Prof. Serpieri con-

cludes (*Real. Ist. Lomb Rend*) that surfusion of the rain-drops is not indispensable to its production. Surfusion indeed accelerates it, as do also violence of wind and intense cold; but a rain with temperature not so low as zero falling into an air-current in rapid motion and below zero gives the phenomenon It is pointed out, however, that the mist which usually accompanies verglas being driven against objects by the wind, and its particles being in a state of surfusion (the temperature being below zero), probably contributes to the general result, helping to make the ice-layer regular and uniform. If the verglas be such that the drop freezes wholly at once, the latter has probably contained many small crystals of ice.

M MERCADIER sums up his researches on Radiophony by saying that he believes that the phenomena are due to a vibratory movement set up by the alternate heating and cooling, due to the intermittent beams of heat-rays, of the gaseous layer adjacent to the solid surface at which the radiations are absorbed, being an anterior layer in the case of solid bodies, a posterior layer in the case of transparent bodies.

M. JANSSEN has succeeded in photographing the *lumière cendrée*, or "earth-shine" on the moon when three days old in the photograph the "continents" were to be distinguished clearly from the "seas." This disposes of the view sometimes advanced, and held, we believe, by some most eminent astronomers, that the "new moon in the arms of the old" was an optical illusion.

PROF D W. BEETZ, of the Technical High School of Munich, wishes us to say that in the note (vol xxiii p 442) on the modulus of elasticity of rods of carbon, he, and not Herr Holtz, should have been mentioned as the author of the paper on the subject in *Wied Ann*

GEOGRAPHICAL NOTES

AT the meeting of the Geographical Society on Monday Mr. J. B. Minchin, who has spent some seven years in the country, read an excellent paper on Eastern Bolivia, which also included some observations on the Gran Chaco. After some preliminary remarks Mr Minchin dwelt at length on the water-system of the country, and, speaking first of the lakes, he mentioned that between the Rivers Pilcomayo and Paraguay, in the unexplored Chaco, the Indians report the existence of a lake which no white man has ever yet seen, but which is perhaps near 22° S lat The rivers belong to Amazon and Plate systems, and with the exception of the Paraguay and the Itenez, they mostly have their sources among the highest summits of the Andes. The Parapite, Mr. Minchin added, is the most southerly affluent of the Amazons, which in some maps has been made to flow across the Chaco into the Paraguay. The Pilcomayo also does not, as has been thought, receive any tributaries on its course through the Chaco, so far as can be learned from the Indians Mr. Minchin afterwards alluded to his expedition over the Matto Grosso Mountains, which he succeeded in crossing for the first time. The latter part of the paper was largely devoted to the animal and vegetable productions of Eastern Bolivia and to the commercial condition of the country. The discussion which followed turned chiefly on the route of the future into Bolivia, whether it would be most advantageous to follow the Paraguay route or develop a new one by the Madera.

MR. E. G. RAVENSTEIN has nearly completed for the Council of the Geographical Society the large map of Eastern Equatorial Africa, on which he has been engaged for nearly three years under the direction of their Scientific Purposes Committee The original drawings will be reduced before they are engraved, and the map when published will be in twenty-four sheets, and on a scale of 1 1,000,000 It will take in the lake region, the Upper Congo, and the Upper Nile, and on the east coast will extend from Somali Land to a little south of the Zambesi, the precise limits of the map being from 10° N. to 20° S. lat, and from 25° to 52° E. long A very complete bibliography of authorities, compiled *pari passu* with the map, will be published afterwards

MR. BROUMTON, an agent of the China Inland Mission at Kweiyang-fu, in the province of Kweichow, has lately sent home an account of a visit which he had paid by invitation to the Miao-tsze tribes a short distance off. He had been told by one of them, from whom he had been learning something of the language, that in the third moon of the year his people had large gatherings in the hills, and was asked to be present at these festivities. He accordingly went and had an excellent opportunity for observing the manners and customs of this section of this comparatively unknown people. He describes their dress, the character of the festivities witnessed, the singular musical instruments used, &c. The particular tribes visited by Mr. Broumton are known as the Black (from the colour of their clothes) and the Ka-teo tribes, and live near Hwangping-chow.

MR. CARL BOCK is leaving for Siam next week, where he intends to make an excursion into the interior His book, "The Headhunters of Borneo," will be published shortly by Messrs. Sampson Low and Co.

WE hear that Mr. Edward Whymper, who has already given an account of some phases of his South American journey to the Alpine Club and the Society of Arts, will read a paper on the Andes of Ecuador before the Geographical Society on May 9.

PRIZES OF THE PARIS ACADEMY OF SCIENCES

AT the public *séance* of the Academy on March 14 the annual distribution of prizes took place. While many of these prizes are offered for particular subjects, others are devoted to rewarding the most important advances made during the year in special departments of science.

The Grand Prize of the Mathematical Sciences was awarded to M Halphen for work on the theory of linear differential equations

In astronomy Mr. Stone receives the Lalande prize for his stellar researches, following those of Abbé de Lacaille, at the Cape of Good Hope, and the Valz prize goes to M. Tempel for his observations on comets M. Vinot's labours in starting and editing *Le Ciel* are recognised by the award of the Tremont prize.

The Montyon prize of the mechanical arts is given to M. Cornut for his study of the faults of iron plates, the Poncelet prize to M. Léauté for various works, while a recompense of 1500 francs on the Bordin foundation is given to M. Lan for improved modes of combustion, diminishing the trouble and harm from smoke, &c (in steel heating). The extraordinary prize of 6000 francs (for improving the efficacy of naval forces), and the Plumey prize, are not awarded.

In physics we find a recompense of 3000 francs given to M. Ader, on the Vaillant foundation, for improvements in phonetic telegraphy. The grand prize for researches on elasticity of crystalline bodies is not awarded

The Jecker prize goes to M. Demarçay for important work in organic chemistry, the Gegner prize to M. Jacquelain for skill in preparing a large number of substances in a pure state, &c

Two prizes on the Bordin foundation are awarded in geology, one to M Gosselet for a geological sketch of the North of France, the other to MM. Falsan and Chantre for their geological monography of ancient glaciers and erratic deposits in the middle of the Rhone Valley Recompenses on the Gay foundation are awarded to MM Delage and Chevremont for observations on movements of the coast-line in France.

In medicine and surgery three Montyon prizes are awarded: one to Dr Charcot for his work on localisation of disorders of the brain; another to Dr Sappery for researches on the lymphatic apparatus of fishes; the third to Dr Jullien for important medical researches On the Bréant foundation M. Colin is awarded 5000 francs for physiological researches Dr Segond receives the Godard prize for an important work in surgery, Dr. Quinand the Barbier prize for researches on the quantity of oxygen in human blood in health and in disease. The Dusgate prize (having regard to prevention of premature burial) is not given, but MM. Onimus, Peyrand, and Le Bon are recompensed for their researches. The Boudet prize is awarded to Prof. Lister.

In experimental physiology the Montyon prize is given to M Bonnier for researches on the nectaries and colours of plants.

The Fons-Melicocq prize for botanical research in the north of France is gained by M. de Vicq; and M. de la Chapelle receives 1000 francs on the Desmazières foundation for studies on French cryptogams.

In anatomy and zoology the Grand Prize with reference to distribution of marine animals on the French coast is withheld.

M. Grandidier gains the Savigny prize for researches on the fauna of Zanzibar and Madagascar, while the Thorel prize is awarded both to M Vayssières and M. Joly, for observations proving a small animal found in streams to be the larva of an insect of the family of Ephemerans.

The Montyon prize for statistics goes to Dr. Ricoux for his "Figured Demography of Algeria"

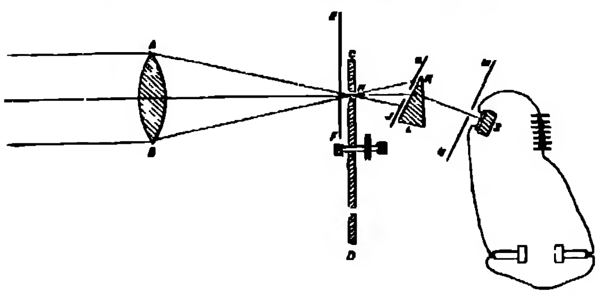
We further note that M. Birckel receives 1500 francs on the Montyon foundation, for an improvement in the Davy lamp, and that M Dupuis receives the Delaland-Guerineau prize for his explorations in Tonkin.

The published list of subjects for prize competition in 1881, 1882, 1883, and 1885 comprises the following subjects (briefly stated) among others.—Motor for tramways, physiology of champignons; influence of environment on plant-organs; structure and development of cork, internal organisation of European edriophthalmate crustaceans, cure of Asiatic cholera, genito-urinary organs; revision of the theory of Jupiter's satellites, elasticity of crystalline bodies, origin of atmospheric electricity, and causes of electric phenomena in thunderstorms, inoculation as a prophylactic for domestic animals; coloured parts of the tegumentary system of animals, and fecundating matter of animated beings, marine, lacustrine, and terrestrial deposits on the French coast since the Roman epoch, botany of the North of France, diagnostic signs of death and prevention of premature burial.

MEASURING THE INDEX OF REFRACTION OF EBONITE [1]

PROF BELL found that when an intermittent beam of light fell on a sensitive selenium cell the sound produced in a telephone (which with a battery was attached to the selenium) was not entirely destroyed by interposing a thin sheet of ebonite in the path of the intermittent rays of light, or, in other words, that ebonite was slightly transparent for invisible rays that affected selenium It occurred to us some months ago that if such invisible rays were at all of the nature of light, they probably suffered retardation in passing through the ebonite, or that refraction would take place if the sheet of ebonite were replaced by an ebonite prism or lens, a result we have been able experimentally to confirm, and at the same time to measure the index of refraction

A B is a glass lens concentrating a parallel beam coming from a lime-light on to one hole H in a rapidly revolving brass disk C D. This disk we have constructed many times as thick as the



one employed by Prof. Bell, and have thus succeeded in eliminating all the sound produced by the syren action of the disk, so disturbing in delicate experiments. E F is a stationary zinc screen with a hole in it smaller than the holes in the rotating disk.

1 We first tried to focus these intermittent rays on a selenium cell by means of an *ebonite* lens, and so determine the focal length of the lens; but as our lens was then not mounted on an optical bench, so as to be moved parallel to itself, or rotated through known angles, and as the rays were invisible, so that our eyes could not of course guide us as to the proper position in which to put the lens, we failed to succeed in this very delicate experiment, which however our subsequent experiments, now to be described, show must ultimately succeed with the lens properly mounted.

2. A small portion of the intermittent light which passed through the hole H in the rotatory disk was allowed to fall on an ebonite prism K L, by passing through a slit in a zinc screen G J, the slit being arranged parallel to the edge of the ebonite prism The prism employed had an angle of 27°·5. M N is another zinc screen with a slit in it also parallel to the edge of the prism, and placed in front of a sensitive selenium cell S (the cell described by us in the account of our experiments on "Seeing by Electricity"). This screen M N was moved parallel to itself, while an experimenter listened with a telephone to each ear, and who was placed in another room, so as not to be influenced by seeing what changes were being made in the position of the screen or in the position of the ebonite prism. The telephones had each a resistance of 74 ohms, and the battery an electromotive force of about 40 volts No direct light falling on the selenium, the listener at the telephones heard nothing for the majority of positions of the screen M N, but in one position represented in the figure a faint distant sound was distinctly heard, which was entirely cut off by interposing the hand in front of the selenium, or by moving away the prism

The invisible rays that affect selenium after passing through ebonite are consequently refracted, and some preliminary experiments, when the ebonite prism was arranged for minimum deviation, gave 1·7 as a first rough approximation for the index of refraction of these rays by ebonite It is interesting to notice that the square, 2 89, of this index of refraction is between the highest and lowest limits obtained by different experimenters for the specific inductive capacity of ebonite, so far agreeing with Maxwell's electromagnetic theory of light

We are now having prisms of ebonite and of other opaque substances of different angles mounted on a goniometer stand, to enable us to measure the indices of refraction accurately

[1] Note communicated to the Royal Society by Professors Ayrton and Perry.

MOLECULAR ELECTROMAGNETIC INDUCTION [1]

THE induction currents balance which I had the honour of bringing before the notice of the Royal Society (*Proc* Roy Soc vol xxix p 56) showed how extremely sensitive it was to the slightest molecular change in the composition of any metal or alloy, and it gave strong evidence of a peculiarity in iron and steel which its magnetic properties alone failed to account for We could with all non-magnetic metals easily obtain a perfect balance of force by an equivalent piece of the same metal, but in the case of iron, steel, and nickel it was with extreme difficulty that I could obtain a near approach to a perfect zero. Two pieces of iron cut off the same bar or wire, possessing the same magnetic moment, never gave identical results, the difficulty consisted, that notwithstanding each bar or wire could be easily made to produce the same inductive reaction, the time during which this reaction took place varied in each bar, and although I could easily change its balancing power as regards inductive force by a change in the mass of the metal, by heat or magnetism, the zero obtained was never equal to that obtained from copper or silver.

This led me to suppose the existence of a peculiarity in magnetic metals which could not be accounted for except upon the hypothesis that there was a cause, then unknown, to produce the invariable effect

Finding that it would be impossible to arrive at the true cause without some new method of investigation, which should allow me to observe the effects from an electrical circuit, whose active portion should be the iron wire itself, I constructed an apparatus or electro-magnetic induction balance, consisting of a single coil reacting upon an iron wire in its axis, and perpendicular to the coil itself; by this means the iron or other wire itself became a primary or secondary, according as the current passed through the coil or wire. Now with this apparatus we could induce secondary currents upon the wire or coil, if the coil was at any angle, except when the wire was absolutely perpendicular, in this state we could only obtain a current from some disturbing cause, and the current so obtained was no longer secondary but tertiary

The whole apparatus however is more complicated than the general idea given above, as it was requisite not only to produce effects, but to be able to appreciate the direction of the electrical current obtained, and have comparative measures of their value. In order to fully understand the mode of experiments, as well as the results obtained, I will first describe the apparatus employed.

The electro-magnetic induction balance consists—(1) of an

[1] Paper read at the Royal Society, March 17, by Prof D E Hughes, F R S

instrument for producing the new induction current; (2) sonometer or balancing coils; (3) rheotome and battery; (4) telephone.

The essential portion of this new balance is that wherein a coil is so arranged that a wire of iron or copper can pass freely through and forming its axis, the iron or copper wire rests upon two supports 20 centims apart; at one of these the wire is firmly clamped by two binding screws; the opposite end of the wire turns freely on its support, the wire being 22 centims. long, having 2 centims projection beyond its support, in order to fasten upon it a key or arm which shall serve as a pointer upon a circle giving the degrees of torsion which the wire receives from turning this pointer A binding screw allows us to fasten the pointer at any degree, and thus preserve the required stress the time required

The exterior diameter of the coil is 5½ centims, having an interior vacant circular space of 3½ centims., its width is 2 centims, upon this is wound 200 metres of No. 32 silk-covered copper wire. This coil is fastened to a small board so arranged that it can be turned through any desired angle in relation to the iron wire which passes through its centre, and it can also be moved to any portion of the 20 centims. of wire, in order that different portions of the same wire may be tested for a similar stress

The whole of this instrument, as far as possible, should be constructed of wood, in order to avoid all disturbing inductive influences of the coil.

The iron wire at its fixed end is joined or makes contact with a copper wire, which returns to the front part of the dial under its board and parallel to its coil, thus forming a loop, the free end of the iron wire is joined to one pole of the battery, the copper wire under the board is joined to the rheotome and thence to the battery.

The coil is joined to the telephone, but, as in every instance we can either pass the battery through the wire, listening to its inductive effects upon the wire, or the reverse of this, I prefer, generally, in order to have no voltaic current passing through the wire, to join the iron wire and its loop direct to the telephone, passing the voltaic current through the coil.

In order to balance, measure, and know the direction of the new induction currents by means of a switching key, the sonometer (*Proc.* Roy Soc., vol. xxix. p. 65) I described to the Royal Society is brought into the circuit The two exterior coils of the sonometer are then in the circuit of the battery, and of the coil upon the board containing the iron wire or stress bridge. The interior or movable coil of the sonometer is then in the circuit of the iron wire and telephone. Instead of the sonometer constructed as described in my paper to the Royal Society, I prefer to use one formed upon a principle I described in *Comptes rendus*, December 30, 1878. This consists of two coils only, one of which is smaller and turns freely in the centre of the outside coil. The exterior coil being stationary, the centre coil turns upon an axle by means of a long (20 centims.) arm or pointer, the point of which moves over a graduated arc or circle. Whenever the axis of the interior coil is perpendicular to the exterior coil no induction takes place, and we have a perfect zero, by turning the interior coil through any degree we have a current proportional to this angle, and in the direction in which it is turned. As this instrument obeys all the well known laws for galvanometers, the readings and evaluations are easy and rapid.

If the coil upon the stress bridge is perpendicular to the iron wire, and if the sonometer coil is at zero, no currents or sounds in the telephone will be perceived, but the slightest current in the iron wire produced by torsion will at once be heard, and by moving the sonometer coil in a direction corresponding to the current, a new zero will be obtained, which will not only balance the force of the new current, but indicate its value. A perfect zero however will not be obtained with the powerful currents obtained by the torsion of 2 millims diameter iron wire, we then require special arrangements of the sonometer, which are too complicated to describe here.

The rheotome is a clockwork having a rapid revolving wheel which gives interruptions of currents in fixed cadences in order to have equal intervals of sound and silence. I employ four bichromate cells or eight Daniell's elements, and they are joined through this rheotome to the coil on the stress bridge, as I have already described.

The magnetic properties of iron, steel, nickel, and cobalt have been so searchingly investigated by ancient as well as by modern scientific authors, that there seems little left to be known as regards its molar magnetism I use the word molar here simply to distinguish or separate the idea of a magnetic bar of iron or steel magnetised longitudinally or transversely from the polarised molecules which are supposed to produce its external magnetic effects.

Molar magnetism, whilst having the power of inducing an electric current in an adjacent wire, provided that either has motion or a change in its magnetic force, as shown by Faraday in 1832, has no power of inducing an electric current upon itself or its own molar constituent, either by motion or change of its magnetic moment. Molecular magnetism (the results of which I believe I have been the first to obtain) has no, or a very feeble, power of inducing either magnetism or an electric current in an adjacent wire, but it possesses the remarkable power of strongly reacting upon its own molar wire, inducing (comparatively with its length) powerful electric currents, in a circuit of which this forms a part.

We may have also both cases existing in the same wire, this occurs when the wire is under the influence of stress, either external or internal, it would have been most difficult to separate these two, as it was in my experiments with the induction balance without the aid of my new method.

Ampère's theory supposes a molecular magnetism or polarity, and that molar magnetism would be produced when the molecular magnetism became symmetrical, and his theory I believe is fully capable of explaining the effects I have obtained, if we admit that we can rotate the paths of the polarised molecules by an elastic torsion.

Matteucci made use of an inducing and secondary coil in the year 1847 (*Compt. rend* t. xxiv. p. 301, 1847), by means of which he observed that mechanical strains increased or decreased the magnetism of a bar inside this coil.

Wertheim published in the *Comptes rendus*, 1852 (*Compt rend.* t. xxv, p 702, 1852), some results similar to Matteucci, but in the *Annales de Chimie et de Physique*, 1857 (*Ann de Chim et de Phys* (3) t l p 385, 3857), he published a long series of most remarkable experiments, in which he clearly proves the influence of torsion upon the increment or decrement of a magnetical wire.

Vilari showed (*Poggendorff's Annalen*, 1868) increase or diminution of magnetism by longitudinal pull according as the magnetising force is less or greater than a certain critical value

Wiedermann (Wiedermann's "Galvanismus," p 447), in his remarkable work, "Galvanismus," says that an iron wire through which an electric current is flowing becomes magnetised by twisting the wire. This I have repeated, but found the effects very weak, no doubt due to the weak battery I use, viz. four quart bichromate cells

Sir W. Thomson shows clearly in his remarkable contribution to the *Phil Trans* Roy. Soc., entitled "Effects of Stress on the Magnetisation of Iron, Nickel, and Cobalt" (*Phil Trans.* May 6, 1878), the critical value of the magnetisation of these metals under varying stress, and also explains the longitudinal magnetism produced by Wiedermann as due to the outside molar twist of the wire, making the current pass as in a spiral round a fixed centre. Sir William Thomson also shows clearly the effects of longitudinal as well as transversal strains, both as regards its molar magnetism and its electric conductivity

My own researches convince me that we have in molecular magnetism a distinct and separate form of magnetism from that when we develop, or render evident, longitudinal or transversal magnetism, which I have before defined as molar.

Molecular magnetism is developed by any slight strain or twist other than longitudinal, and it is only developed by an elastic twist, for however much we may twist a wire, provided that its fibres are not separated, we shall only have the result due to the reaction of its remaining elasticity.

If we place an iron wire, say 20 centims. long, 1 millim. diameter, in the axis of the coil of the electro-magnetic balance, and if this wire is joined, as described, to the telephone, we find that on passing an electric current through the inducing coil no current is perceptible upon the iron wire, but if we give a very slight twist to this wire at its free end—one-eighteenth of a turn, or 20°—we at once hear, clear and comparatively loud, the currents passing the coil; and although we only gave a slight elastic twist of 20° of a whole turn, and this spread over 20 centims. in length, making an extremely slight molar spiral; yet the effects are more powerful than if, using a wire free from stress, we

turned the whole coil 40°. The current obtained when we turn the coil, as just mentioned, is secondary, and with the coil at any angle any current produced by its action, either on a copper, silver, iron, or steel wire ; in fact it is simply Faraday's discovery, but the current from an elastic twist is no longer secondary under the same conditions, but tertiary, as I shall demonstrate later on The current passing through the coil cannot induce a current upon a wire perpendicular to itself, but the molecules of the outside of the wire, being under a greater elastic stress than the wire itself, they are no longer perpendicular to the centre of the wire, and consequently they react upon this wire as separate magnets would upon an adjacent wire It might here be readily supposed that a wire having several twists, so a fixed molar twist of a given amount would produce similar effects. It however does not, for in most cases the current obtained from the molar twists are in a contrary direction to that of the elastic torsion. Thus, if I place an iron wire under a right-handed elastic twist of 20° I find a positive current of 50° sonometer, but if I continue this twist so that the index makes one or several entire revolutions, thus giving a permanent molar twist of several turns, I find upon leaving the index free from any elastic torsion, that I have a permanent current of 10°, but it is no longer positive but negative, requiring that we should give an elastic torsion in the previous direction, in order to produce a positive current Here a permanent elastic torsion of the molecules is set up in the contrary direction to its molar twist, and we have a negative current, overpowering any positive current which should have been due to the twisted wire

The following table shows the influence of a permanent twist, and that the current obtained when the wire was freed from its elastic torsion was in opposition to that which should have been produced by the permanent twist Thus a well-softened iron wire 1 millim in diameter, giving 60° positive current for a right handed elastic torsion of 20°, gave after 1°·80 permanent torsion a negative current of 10°

1	complete permanent torsion	(right-handed)	negative		10
2	"	"	"		15
3	"	"	"		15
4	"	"	"		16
5	"	"	"		12
6	"	"	"		10
7	"	"	"		5
8	"	"	"		4
9	"	"	"		3
10	"	"	"		3

At this point the fibres of a soft wire commence to separate, and we have no longer a complete single wire, but a helix of separate wires upon a central structure

If now, instead of passing the current through the coil, I pass it through the wire, and place the telephone upon the coil circuit, I find that I obtain equally as strong tertiary currents upon the coil as in the previous case, although in the first case there was produced longitudinal electro-magnetism in the perpendicular wire by the action of the coil, but in the latter case none or the most feeble electro-magnetism was produced, yet in these two distinct cases we have a powerful current produced not only upon its own wire, but upon the coil, thus proving that the effects are equally produced both on the wire and coil.

If we desire, however, in these reversible effects to produce in both cases the same electromotive force, we must remember that the tertiary current when reacting upon its own short wire produces a current of great quantity, the coil one of comparative higher intensity. We can, however, easily convert the great quantity of the wire into one of higher tension by passing it through the primary of a small induction coil whose resistance is not greater than one ohm. We can join our telephone, which may be then one of a high resistance, to the secondary of this induction coil, and by this means, and without changing the resistance of the telephone, receive the same amount of force, either from the iron wire or the coil.

Finding that iron, steel, and all magnetic metals produce a current by a slight twist, if now we replace this wire by one of copper or non-magnetic metals we have no current whatever by an elastic twist, and no effects, except when the wire itself is twisted spirally in helix, and whatever current we may obtain from copper, &c., no matter if from its being in spiral or from not being perpendicular to the axis of the coils, the currents obtained will be invariably secondary and not tertiary. If we replace the copper by an iron wire, and give it a certain fixed torsion, not passing its limit of elasticity, we find that no increase or decrease takes place by long action or time of being under strain Thus a wire which gave a sonometric force of 50° at the first observation remained perfectly constant for several days until it was again brought to zero by taking off the strain it had received. Thus we may consider that as long as the wire preserves its elasticity, exactly in the same ratio will it preserve the molecular character of its magnetism

It is not necessary to use a wire to produce these effects, still more powerful currents are generated in bars, ribbons, or sheets of iron, thus no matter what external form it may possess, it still produces all the effects I have described

It requires a great many permanent twists in a wire to be able to see any effect from these twists, but if we give to a wire, 1 millim. diameter, forty whole turns (or until its fibres become separated) we find some new effects, we find a small current of 10° in the same direction as its molar twist, and on giving a slight twist (20°) the sonometric value of the sound obtained is 80° instead of 50°, the real value of a similar untwisted wire ; but its explanation will be found by twisting the wire in a contrary direction to its molar twist We can now approach the zero but never produce a current in the contrary direction, owing to the fact that by the spiral direction, due to the fibrous molar turns, the neutral position of its molecule is no longer parallel with its wire, but parallel with its molar twist, consequently an elastic strain in the latter case can only bring the molecules parallel with its wire, producing no current, and in the first case the angle at which the reaction takes place is greater than before, consequently the increased value of its current

The measurements of electric force mentioned in this paper are all sonometric on an arbitrary scale Their absolute value has not yet been obtained, as we do not, at our present stage, require any except comparative measures.[1] Thus, if each wire is of 1 millim diameter and 20 centims long, all render the same stress in the axis of its coil I find that the following are the sonometric degrees of value —

Soft iron	60°	Tertiary current.
Hard drawn iron	50	" "
Soft steel	45	" "
Hard tempered steel	10	" "
Copper, silver, &c	– 0	" "
Copper helix, 1 centim. diameter, 20 turns in 20 centims.	45	Secondary currents.
Iron, spiral, ditto	45	" "
Steel	45	" "

The tertiary current increases with the diameter of the wire, the ratio of which has not yet been determined, thus an ordinary hard iron wire of 1 millim. diameter giving 50°, one of 2 millims diameter gave 100°, and the maximum of force obtained by any degree of torsion is at or near its limit of elasticity, as if in the same time we also pass this point, producing a permanent twist, the current decreases, as I have already shown in the case of a permanent twist Thus, the critical point of 1 millim. hard iron wire was 20° of torsion, but in hard steel it was 45°.

Longitudinal strains do not produce any current whatever, but a very slight twist to a wire, under a longitudinal strain, produces its maximum effects · thus, 20° of torsion being the critical point of iron wire, the same wire, under longitudinal strain, required but from 10° to 15°. It is very difficult however to produce a perfect longitudinal strain alone I have therefore only been able to try the effect of longitudinal strain on fine wires, not larger than 1 millim in diameter, but as in all cases no effect whatever was produced by longitudinal strain alone, I believe none will be found if absolutely free from torsion. The molecules in a longitudinal strain are equally under an elastic strain as in torsion, but the path of their motion is now parallel with its wire, or the zero of electric inductive effect, but the compound strain composed of longitudinal and transverse, react upon each other, producing the increased effect due to the compound strain

The sonometer is not only useful for showing the direction of the current and measuring it by the zero method, but it also shows at once if the current measured is secondary or tertiary If the current is secondary its period of action coincides with that of the sonometer, and a perfect balance, or zero of sound, is at once obtained, and its value in sonometric degrees given, but if the current is tertiary, no zero is possible, and if the value of the tertiary is 60°, we find 60° the nearest approach to zero

[1] 90° sonometer has the same electromotive force as 0°·10 of a Daniell battery

possible But by the aid of separate induction coils to convert the secondary into a tertiary, a perfect zero can be obtained if the time of action and its force correspond to that which we wish to measure

If I place a copper wire in the balance and turn the coils at an angle of 45°, I obtain a current which can be perfectly balanced by the sonometer at 50°, proving, as already said, that it is secondary. If I now replace the copper by an iron wire, the coil remaining at 45°, I have again exactly the same value for the iron as copper, viz., 50°, and in both cases secondary Now, it is evident that in the case of the iron wire there was produced at each passage of the current a strong electro-magnet, but this longitudinal magnetism did not either change the character of the current or its value in force.

A most beautiful demonstration of the fact that longitudinal magnetism produces no current, but that molecular magnetism can act equally as well, no matter the direction of the longitudinal magnetism, consists in forming an iron wire in a loop, or taking two parallel but separate wires, joined electrically at their fixed ends, the free ends being each connected with the circuit, so that the current generated must pass up one wire and down the adjacent one On testing this loop, and if there are no internal strains, complete silence or absence of current will be found. Now, giving a slight torsion to one of these wires in a given direction, we find, say 50° positive; twisting the parallel wire in a similar direction produces a perfect zero, thus, the current of the second must have balanced the positive of the first. If, instead of twisting it in similar directions, we twist it in the contrary direction, the sounds are increased in value from 50° positive to 100° positive, showing, in this latter case, not only a twofold increase of force, but that the currents in the iron wires travelled up one wire and down the other, notwithstanding that both were strongly magnetic by the influence of the coil in one direction, and this experiment also proves that its molar magnetism had no effect, as the currents are equally strong in both directions, and both wires can double or efface the currents produced in each If instead of two wires we take four, we can produce a zero, or a current of 200°, and with twenty wires we have a force of 1000°, or an electromotive force of two volts We have here a means of multiplying the effects by giving an elastic torsion to each separate wire, and joining them electrically in tension If loops are formed of one iron and one copper wire, we can obtain both currents from the iron wire, positive and negative, but none from the copper, its *rôle* is simply that of a conductor upon which torsion has no effect.

I have already mentioned that internal strains will give out tertiary currents without any external elastic strain being put on In the case of iron wire these disappear by a few twists in both directions, but in flat bars or forged iron they are more permanent, evidently portions of these bars have an elastic strain, whilst other portions are free, for I find a difference at every inch tested the instrument however is so admirably sensitive and able to point out not only the strain but its direction, that I have no doubt its application to large forged pieces, such as shafts or cannon, would bring out most interesting results, besides its practical utility; great care is therefore necessary in these experiments that we have a wire free from internal strains, or that we know their value.

Magnetising the iron wire by a large steel permanent magnet has no effect whatever. A hard steel wire thus placed becomes strongly magnetic, but no current is generated, nor has it any influence upon the results obtained from molecular movement, as in elastic torsion. A flat wide iron or steel bar shows this better than iron wire, as we can here produce transversal instead of longitudinal, but neither shows any trace of the currents produced by molecular magnetism. I have made many experiments with wires and bars thus magnetised, but as the effect in every case was negative when freed from experimental errors, I will not mention them, but there is one very interesting proof which the instrument gives, that longitudinal magnetism first passes through its molecular condition before and during the discharge or recomposition of its magnetism For this purpose, using no battery, I join the rheotome and telephone to the coil, the wire having no exterior circuit. If I strongly magnetise the two ends of the wire, I find by rapidly moving the coil that there is a Faradaic induction of 50° at both poles, but very little or none at the centre of the wire; now fixing the coil at the central or neutral point of the wire and listening intently, no sounds are heard, but the instant I give a slight elastic torsion to the free pole, a rush of electric tertiary induction is heard, whose value is 40°. Again, testing this wire by moving the coil, I find only a remaining magnetism of 10, and upon repeating the experiment of elastic torsion I find a tertiary of 5; thus we can go on gradually discharging the wire, but its discharge will be found to be a recomposition, and that it first passed through the stage I have mentioned.

Heat has a very great effect upon molecular magnetic effects. On iron it increases the current, but in steel the current is diminished. For experimenting on iron wire, which gave a tertiary current of 50° positive (with a torsion of 20°), upon the application of the flame of a spirit-lamp the force rapidly increases (care being taken not to approach red-heat) until the force is doubled, or 100 positive The same effects were obtained in either direction, and were not due to a molar twist or thermo-current, as if care had been taken to put on not more than 10° of torsion, the wire came back to zero at once on removal of the torson Hard tempered steel, whose value was 10° whilst cold, with a torsion of 45°, become only 1° when heated, but returned (if not too much heated) to 8° when cold I very much doubted this experiment at first, but on repeating the experiment with steel several times I found that on heating it I had softened the extreme hard (yellow) temper to that of the well-known blue temper. Now at blue temper, hot, the value of steel was but 1° to 2°, whilst soft iron of a similar size gave 50° of force cold, and 100° at red heat Now as I have already shown that the effects I have described depend on molecular elasticity, it proves at least, as far as iron and steel are concerned, that a comparatively perfect elastic body, such as tempered steel, has but slight molecular elasticity, and that heat reduces it, but that soft iron, having but little molar elasticity, has a molecular elasticity of a very high degree, which is increased by heat.

The objects of the present paper being to bring the experimental facts before the notice of the Royal Society, and not to give a theoretical solution of the phenomena, I will simply add that if we assume with Poisson that the paths of the molecules of iron are circles, and that they become ellipses by compression or strain, and also that they are capable of being polarised, it would sufficiently explain the new effects

Joule has shown that an iron bar is longer and narrower during magnetisation than before, and in the case of the transverse strain the exterior portions of the wire are under a far greater strain than those near the centre, and as the polarised ellipses are at an angle with the molecules of the central portions of the wire, its polarisation reacts upon them, producing the comparatively strong electric currents I have described.

SCIENTIFIC SERIALS

Transactions and Proceedings of the Botanical Society of Edinburgh, vol xiv, part 1, 1881, contains—Address by the president, Dr T A G Balfour (this address gave brief obituary of J M'Nab, Sir W C. Trevelyan, Dr. M. Bain, Prof Grisebach, A. Forbes, A. J Adie, Dr J. Cumming, Karl Koch, Dr J Murchison, Dr. D Moore, P S. Robertson, Wm Mudd, Dr J. F. Th. Irmisch, S Hay, Dr. M A. E. Wilkinson, Rev. W. B. Cunningham, E V. Sandilands, and A. Graham).—Dr. W. Traill, on the growth of *Phormium tenax* in the Orkney Islands.—Wm Gorrie, on the hardiness of New Zealand plants (1878-79)—Prof. G Lawson, on British-American species of Viola—S Grieve, flora of Colonsay and Oransay.—Jas. Blaikie, botanical tour in Engadine—Sir R. Christison, on the measurement of trees.—Prof. J H. Balfour, on *Rheum nobile*.—P. M. Thomson, the flowering plants of New Zealand, and their relation to the insect fauna.—J. Sadler, on the flowering of *Yucca gloriosa*—Prof Dickson, on the septa across the ducts in *Bougainvillea glabra* and *Testudinaria elephantipes*.

Proceedings of the Linnean Society of New South Wales, vol. v., parts 1 and 2 (1880).—F. M. Bailey, medicinal plants of Queensland, on Queensland ferns, with descriptions of two new species; on a new species of Nepenthes.—M. A. Haswell, on some Queensland Polyzoa, plates 1 to 3; on some new Amphipods, plates 5 to 7.—Wm Macleay, on a new species of Galaxias, with remarks on the distribution of the species; on a new species of Otolithus and of Synaptura.—Rev. E. T. Woods and F. M. Bailey, on the fungi of New South Wales and Queensland.—Rev. E T Woods, on the littoral marine fauna of North-East Australia, on a fossiliferous bed at the mouth of the Endeavour River; on the habits of some Australian Echini. —E. P. Ramsay, on a new species of Oligorus; note on *Galeo-*

cerdo Raynerі.—Prof. Ralph Tate, rectification of the nomenclature of *Purpura anomala*, Angas.—E. Meyrick, descriptions of Australian Microlepidoptera, parts 3 and 4, Tineina.—J Brazier, on a new variety of *Bulimus Caledonicus*

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, March 17.—Prof. Roscoe, president, in the chair.—The following papers were read:—On the volume of mixed liquids, by F D Brown. The author has determined with very great care the alteration in volume which takes place when various liquids are mixed. The liquids experimented with were carbon disulphide and benzene, carbon disulphide and carbon tetrachloride, carbon tetrachloride and benzene, dichlorethane and benzene, dibromethane and benzene, and carbon tetrachloride and toluene. The experiments were made at 20° C. The author concludes that these changes of volume are dependent on the chemical character of the molecules, and not on such physical properties as vapour tension, molecular volume, &c.—On the action of alcohol on mercuric nitrate, by R Cowper. When mercury is dissolved in twelve times its weight of nitric acid (1 3), the solution allowed to stand until all nitrous fumes have escaped, and twelve parts by weight of pure alcohol added, a crystalline precipitate is formed, with or without heating, which the author has investigated; it has the constitution $(C_2H_3Hg_3O_2)(NO_3)_2$, he has also prepared the hydrate and oxalate of the dyad radical $(C_2H_3Hg_3O_2)$.—On boron hydride, by F. Jones and R. L. Taylor. Magnesium boride is first prepared by heating a mixture of recently-ignited boric anhydride, with twice its weight of magnesium dust, in a covered crucible. On treating the magnesium boride with hydrochloric acid, boron hydride is obtained, always however mixed with a large excess of hydrogen. Its composition is probably BH_3, it resembles in many of its properties arsine (AsH_3) and stibine (SbH_3).—On the action of aldehydes on phenanthraquinone in presence of ammonia, by F R. Japp and E. Wilcock.—On the action of benzoic acid on naphthaquinone, by F. R Japp and N H J Miller.—Note on the appearance of nitrous acid during the evaporation of water, by R Warington. The author proves that the nitrous acid is always derived from the atmosphere or from the products of combustion from the source of heat used for evaporating, he also gave some account of the marvellously delicate test proposed by Griess for nitrous acid. The solution is acidified, and some sulphanilic acid with some hydrochlorate of naphthylamin added, if nitrous acid be present, equal to one part of nitrogen in 1000 millions of water, a rose-red tint is developed.—On the sweet principle of *Smilax glycophylla*, by Dr Wright and Mr. Rennie.—Note on usnic acid and some products of its decomposition, by the late J. Stenhouse and C. E. Groves.—On the absorption of solar rays by atmospheric ozone, and on the blue tint of the atmosphere, by W N. Hartley. The author concludes that the higher regions of the atmosphere contain much more ozone than the layers near the earth's surface, and that the blue tint of the atmosphere is largely due to ozone.—On the nature of certain volatile products contained in crude coal-tar benzenes, by Watson Smith.—On New Zealand Kauri gum, by E H Rennie. On distillation this gum yields a terpene, boiling at 157°–158°

Geological Society, March 9.—Robert Etheridge, F R.S, president, in the chair.—Robert Thompson Burnett, William Erasmus Darwin, Charles James Fox, and the Rev T. Granger Hutt were elected Fellows of the Society.—The following communications were read:—Description of parts of the skeleton of an Anomodont reptile (*Platypodosaurus robustus*, Ow), Part II. The Pelvis, by Prof. Owen, C B, F.R.S. In this paper the author described the remains of the pelvis of *Platypodosarus robustus*, which have now been relieved from the matrix, including the sacrum, the right "os innominatum," and a great part of the left ilium. There are five sacral vertebræ, which the author believes to be the total number in *Platypodosaurus*. The neural canal of the last lumbar vertebra is 8 lines in diameter, and of the first sacral 9 lines, diminishing to 6 lines in the fifth, and indicating an expansion of the myelon in the sacral region, which is in accordance with the great development of the hind limbs. The sacral vertebræ increase in width to the third; the fourth has the widest centrum. This coalescence of the vertebræ justifies the consideration of the mass, as in Mammalia, as one bone or "sacrum," which may be regarded as approaching in shape that of the Megatherioid mammals, although including fewer vertebræ. Its length is 7½ inches, its greatest breadth at the third vertebra, 5½ inches. The ilium forms the anterior and dorsal walls of the acetabulum, the posterior and postero ventral walls of which are formed by the ischium and pubis. The diameter of its outlet is 3 inches, the depth of the cavity 1¼ inch; at its bottom is a fossa 1¼ inch broad. The foramen is subcircular, 1 inch in diameter. The ventral wall of the pelvic outlet is chiefly formed by the pubis; it is a plate of bone 6 inches broad, concave externally, convex towards the pelvic cavity. The subacetabular border is 7–8 lines thick, it shows no indication of a pectineal process, or of a prominence for the support of a marsupial bone. The author remarks that of all examples of pelvic structure in extinct Reptilia this departs furthest from any modification known in existing types, and makes the nearest approach to the Mammalian pelvis. This is shown especially by the number of sacral vertebræ and their breadth, by the breadth of the iliac bones, and by the extent of confluence of the expanded ischia and pubes.—On the order Theriodontia, with a description of a new genus and species (*Ælurosaurus felinus*, Ow), by Prof Owen, C B, F R S. The new form of Theriodont reptile described by the author in this paper under the name of *Ælurosaurus felinus* is represented by a skull with the lower jaw, obtained by Mr. Thomas Bain from the Trias of Gough, in the Karoo district of South Africa. The post-orbital part is broken away. The animal is mononarial, the alveolar border of the upper jaw is slightly sinuous, concave above the incisors, convex above the canines and molars, and then straight to beneath the orbits. The alveolar border of the mandible is concealed by the overlapping teeth of the upper jaw, its symphysis is deep, slanting backward, and destitute of any trace of suture, the length of the mandible is 3¼ inches, which was probably the length of the skull. The incisors are $\frac{5-5}{5-5}$, and the molars probably $\frac{5-5}{5-5}$ or $\frac{6-6}{6-6}$, all more or less laniariform. The length of the exserted crown of the upper canine is 12 millims; the root of the left upper canine was found to be twice this length, extending upwards and backwards, slightly expanded, and then a little narrowed to the open end of the pulp-cavity. There is no trace of a successional canine; but the condition of the pulp cavity and petrified pulp would seem to indicate renewal of the working part of the canine by continuous growth. The author infers that the animal was monophyodont. *Ælurosaurus* was said to be most nearly allied to *Lycosaurus*, but its incisor formula is Dasyurine. With regard to the characters of the Theriodontia the author remarked that we may now add to those given in his "Catalogue of South African Fossil Reptiles" that the humerus is perforated by an entepicondylar foramen and the dentition monophyodont.—Additional observations on the superficial geology of British Columbia and its adjacent regions, by G M. Dawson, D Sc. This paper is in continuation of two already published in the Society's *Journal* (vol xxxi p 603, and vol. xxxv p 89). In subsequent examinations of the southern part of the interior of British Columbia the author has been able to find traces of glaciation in a north to south direction as far as or even beyond the 49th parallel. Iron Mountain, for instance, 3500 feet above the neighbouring valleys, 5280 feet above the sea, has its summit strongly ice-worn in direction N. 29° W. to S 29° E. Other remarkable instances are given which can hardly be explained by local glaciers; boulder-clay is spread over the entire district, terraces are cut in the rearranged material of this, bordering the river-valleys, and at greater elevations expanding over the higher parts of the plateau and mountains. At Mount It-ga-chuz they are 5270 feet above the sea. The author considers that the higher terraces can only be explained by a general flooding of the district. Some of the wide trough-like valleys of the plateau contain a silty material which the author regards as a glacial mud. North of the 54th parallel and west of the Rocky Mountains similar evidence of glaciation is obtained; erratics are found in the Peace and Athabasca basins. The fjords of British Columbia are extremely glaciated, the marls being generally in conformity with the local features, terraces are scarce and at low levels. The Strait of Georgia was filled by a glacier which overrode the south-east part of Vancouver's Island, evidence is given to show that this ice came from the neighbouring mountainous country. Queen Charlotte's Island shows evidence of local glaciation. Boulder-clays and stratified drifts are found, with occasional Arctic shells. The author considers that the most

probable explanation of the phenomena of the whole region is to suppose the former existence of a great glacier mass resembling the inland ice of Greenland, and that the Glacial period was closed by a general submergence, during which the drifts were deposited and, at its close, the terraces cut

Photographic Society, March 8.—J. Glaisher, F.R.S., president, in the chair.—Papers were read by Mr. Payne Jennings on art photography. It was asserted that unfavourable criticisms, both from artists and the press, had been the result from the exhibition of works which deserved such severity, and that to raise the status of art in photography more attention must be given to art-rules.—Also by Mr. Edwin Cocking, on notes on photography and art. An incisive comparison was drawn between the art of the painter and that of the photographer, showing the essential difference between the two in the production of a pictorial work, both in the *modus operandi* of production and the individuality capable of being infused into each result. Also that art in photography required a totally different training to that necessary for the painter, and that the time had arrived when special instruction by a thoroughly organised school for art photography had become absolutely necessary.

Institution of Civil Engineers, March 22.—Mr. Abernethy, F.R.S.E., president, in the chair.—The paper read was on the comparative endurance of iron and mild steel when exposed to corrosive influences, by Mr. D. Phillips, M. Inst. C.E.

PARIS

Academy of Sciences, March 21.—M. Wurtz in the chair.—The following papers were read:—On determination of the masses of mercury, Venus, the Earth, and of solar parallax, by M. Tisserand.—Observations of Faye's comet, at Paris Observatory, by MM. Tisserand and Bigourdan.—On the possibility of making sheep refractory to anthrax through preventive inoculations, by M. Pasteur, with MM. Chamberland and Roux. M. Pasteur controverts M. Toussaint's views on the subject, and says his method is very uncertain.—The vaccine matter of anthrax, by the same. A wholly harmless bacterium can be got from the most virulent by cultivation in animals different from those apt to take the disease. There are as many distinct germs as there are different kinds of virulence.—Researches on formic ethers, by MM. Berthelot and Ogier. They are formed with absorption of heat.—New navigation-maps, giving both the direction and force of the wind in the Indian Ocean, by M. Brault. Meteorologically the parts of that ocean above and below the equator are distinct (and the author indicates how).—On the operations of the Syndical Association of the Beziers Arrondissement to oppose phylloxera, by M. Janssen.—Report on the work of the Council of Public Hygiène and Salubrity, by M. Brezançon.—On the surface with sixteen singular points and Θ functions with two variables, by M. Darboux.—On the functional determinant of any number of binary forms, by M. Le Paige.—On the decomposition into primary factors of uniform functions having a line of essential singular points, by M. Picard.—On certain simultaneous linear differential equations with partial derivatives, by MM. Picard and Appell.—On generator polygons of a relation between several imaginary variables, by M. Lecornu.—Solution of a general problem on series, by M. André.—On linear differential equations with algebraic integrals, by M. Poincaré.—On the distribution of energy in the normal solar spectrum, by Prof. Langley. The total heat coming from the sun to the earth is much greater than has been believed (even in estimates accused of exaggeration). If the totality of the solar radiations reached us we should have a sensation of blue rather than white. (The author studied the absorption for each ray).—On a synthetic apparatus reproducing the phenomenon of circular double refraction, by M. Gouy. This consists of a number of thin and narrow rectangular lamellæ of crystal placed side by side like floor boards, and cemented between two glass plates. In a given direction the optic axis of each band forms a constant angle with the preceding one. A half-wave plate is placed above.—On radiophony with selenium, by M. Mercadier. The sounds here result chiefly from the luminous rays from the limit of blue to extreme red, and even a little in infra-red, the maximum being in the yellow.—Experiments at the Creusot works in optical measurement of high temperatures, by M. Crova. The spectropyrometer is proved practically useful.—On the electromotive force of the voltaic arc, by M. Le Roux. With a galvanometer of great resistance and a single contact operated with the hand, one may prove the difference of potential of the carbons even $\frac{1}{40}$ of a second after cessation of the current. The phenomenon is probably thermo-electric.—The hissing of the voltaic arc, by M. Maudet. The difference of potential between the carbons is very great when the arc is silent, very small when it hisses.—On magic mirrors of silvered glass, by M. Laurent. The magic effect can be had through the mode of mounting of the mirror.—On the flow of gases, by M. Neyreneuf. The laws of this may be verified by a method like that for determining electric resistances.—On new combinations of hydrobromic and hydriodic acid with ammonia, by M. Troost.—Action of hydrochloric acid on chloride of lead, by M. Ditte.—Action of sulphuric acid newly heated to 320°, and oils, by M. Maumené.—On a new means of analysis of oils, by the same. This consists in treating a measured quantity of oil with one of a titrated aqueous solution of caustic alkali.—Separation of oxide of nickel and oxide of cobalt, by M. Delvaux.—On a process of industrial manufacture of carbonate of potash, by M. Engel.—On some complex compounds of sulphur and nitrogen, by M. Demarçay.—On tar from cork, by M. Bordet. It contains more hydrocarbons than tar from coal, and less of oxygenated substances than tar from hard woods.—On the fermentation of urea, by M. Richet. The stomachal mucus of animals in general causes ammoniacal fermentation of pure urea.—Physiological and therapeutical properties of cedrine and valdivine, by MM. Dujardin-Beaumetz and Restrepo.—Physiological action of *Erythrina corallodendron*, by MM. Bochefontaine and Rey.—On lesions of the bones in locomotor ataxy, by M. Blanchard.—On the presence of trichina in adipose tissue, by M. Chatin.—On the virulent state of the fœtus in sheep dead from symptomatic anthrax, by MM. A. Arloing, Cornevin, and Thomas.—Illusion relative to the size and distance of objects from which one withdraws, by M. Charpentier. The objects seem to enlarge on approach.—On the organs of taste of osseous fishes, by M. Jourdan.—Toxical power of pancreatic microzymas in intravenous injections, by MM. Béchamp and Baltus.—Human bones found in the diluvium of Nice—the geological question, by M. Desor. The deposit (at Carabacel) belongs to the category of strata contemporary with the erosion of tertiary plateaux.—Description of the bones, by M. Niepce.—Determination of the race, by M. de Quatrefages. It seems to be the same as that of the men of Cro-Magnon.—On a new genus of primary fish, by M. Gaudry. MM. Roche found it in the Permian of Igornay. It is remarkable for the great size of its ribs, and is called *Megapleuron Rochei*. It had lozenge scales.—On the existence and characters of the Cambrian formation in the Puy-de-Dôme and Allier, by M. Julien.—General law of formation of mineral waters, application to Greoux (Basses-Alpes), by M. Dieulafait.—On the discovery at Noir-Moutier (Vendée) of the Eocene flora with *Sabalites Andegavensis*, Sch., by M. Crié.—Observations on variations of temperature of the human body during movement, by M. Villari. The results agree with M. Bonnal's.

CONTENTS

THURSDAY, APRIL 7, 1881

THE ARYAN VILLAGE

The Aryan Village in India and Ceylon. By Sir John B Phear. (London: Macmillan and Co, 1880)

IT is now twenty years since a remarkable page in Sir Henry Maine's "Ancient Law" drew attention to the prevalence in India of the village-community, a system of society strange to the modern English mind Before that work appeared, even special students had little idea how far the ancient communism, under which the Aryan race colonised so much of Asia and Europe, was still to be found not as a mere relic of ancient society, but as the practical condition of modern life among Hindus and Slavs. The historical importance of this early institution is now fully recognised, and our archæologists are alive to the relics of the old village-communities in England Not only are these seen in the public commons, but here and there in certain fields where, after harvest, the neighbours still have the right of turning their cattle in among the stubbles, while even a few of the great old "common fields," where once each family had its free allotted portion, are still to be discerned by the baulks or ridges of turf dividing them into the three long strips, which again were cut crosswise into the family lots Thus every contribution to the argument on the development of modern landholding from the communism of ancient times, finds interested readers. The present volume is such a contribution, and in several ways new and important Sir John Phear thoroughly knows and carefully describes native life in Bengal and Ceylon, and one of his points is the remarkable parallelism of the agricultural village, as it has shaped itself in these two widely-separated districts Up to a certain stage, the development of the village-community has been everywhere on much the same lines, and those not hard to trace It springs naturally out of the patriarchal family, which, living together on its undivided land, tilling it in common, and subsisting on the produce, becomes in a few generations a family-community. There are now to be seen in and about Calcutta families of 300 to 400 (including servants) living in one house, and 50 to 100 is a usual number. The property is managed by the *karta*, who is usually the eldest of the eldest branch, and what the members want for personal expenses beside the common board and lodging, he lets them have in small sums out of the common fund. Now and then there is a great quarrel, when the community breaks up and the land is divided according to law It is easily seen how such a joint-family or group of families settling together in waste unoccupied land would expand into a village-community, where new households when crowded out of the family home would live in huts hard by, but all would work and share together as if they still dwelt under one roof In fact this primitive kind of village-settlement, according to our author, is still going on at this day in Ceylon In districts where, as in ancient Europe, patches of forest are still felled and burnt to give a couple of years' crop of grain, and where in the lowlands rice-cultivation requires systematic flooding, we find the whole settlement at work in common in a thoroughly socialistic way. The somewhat different communistic system prevails more in India, where the land is still the common property of the village, and the cultivated plots are apportioned out from time to time among the families, but these families labour by and for themselves, pay the rent or tax, and live each on the crop of their own raising. In Bengal a step toward our notion of proprietorship is made, where custom more and more confirms each family in permanent ownership of the fields which their fathers have long tilled undisturbed. Tenant-right, so pertinaciously remembered by the Irish peasant, is older in history than the private ownership of land. Next, in the Hindu village as it now exists, a further stage of social growth appears. Families carrying on certain necessary professions have been set apart, or have settled in the village The hereditary carpenters and blacksmiths and potters follow their trades, the hereditary washerman washes for his fellow-villagers, and the hereditary barber shaves them, paid partly for their services at fixed customary rates, and partly by having their plots of village-land rent free, or nearly so. All this is intelligible and practical enough, and indeed strongly reminds those of us who got our early politics out of "Evenings at Home," of the boy colonists providing for their future wants under the direction of discreet Mr Barlow, by taking with them the carpenter and the blacksmith and the rest of the useful members of society But the village-community as it actually exists in India, or Servia, or anywhere else, only forms the substratum of society, on the top of which appear other social elements whose development it is not so easy to trace with certainty. The "gentleman," with his claims to live in a better house than the others whose business is to drudge for him, seemed absurd to Dr Aikin's political economy, yet he makes his appearance in the Hindu village-community as elsewhere Sir John Phear seems disposed partly to account for what may be called the landholding class, as well as the endowed priesthood, as having held a privileged position from the first settlement of the villages, and it is in favour of this view that in such settlements the founder's kin naturally have superior rights over the land to new-comers. But he does not the less insist on another and yet stronger social process which has tended to give to individuals a landlord-right over fields they do not till. When quarrels between two villages end in actual war, the conquering warriors (whose claims however seem to be here somewhat confused with the rights of the chief's family) would be rewarded for their prowess by grants of land carved out of the common lands of the conquered village, and the new lords being absentees would naturally put in tenants who would pay in return a share of the crops Such metayage, or farming "on shares," is as common in India as in the south of Europe, and is evidently the stage out of which arose our rent-system of landlord and tenant.

One great value of books like the present is in showing the analogies and differences of social institutions which have much of their history in common with our own, but have developed under other conditions Feudal lordship and feudal sovereignty have in the East overridden the old village-system in ways curiously like those of the West. Thus, as Sir John Phear says, the English manor was the feudal form of the Oriental village; the Bengal

zamindar collects rents from his ryots and pays to the superior holder, or the Crown, living on the difference. Singhalese villagers may do suit and service either to a feudal chieftain or a Buddhist monastery, much as in England the fief might have been held either by a fighting baron or a praying abbot. It is interesting to find in Ceylon the notion that the existing tenure of land comes from the king having granted it subject to service, whereas its real history seems just the opposite, that the village-community came first, which the sovereign made himself paramount over and levied land-tax from. This reminds us of the theory of English law, that a cottager pastures his donkey on the common by sufferance of the lord of the manor, whose waste it is; the fact being that the peasant is exercising a relic of his old village-rights which has escaped the usurpation of the feudal system, and outlived it.

Though the village-community is much broken down in the districts so well described by Sir John Phear, it still shows the old framework in the division of the tilled land in allotments to each ryot, and the equitable settlement of rights and duties by the *mandal* or headman and his *panchayat* or village-council, which is one of the most admirable features of the ancient patriarchal system. But on the whole the village commune here shows practical results by no means admirable, and the husbandman's life on the roadless mud-flats of Bengal, minutely drawn by the author in all its details of dreary poverty and ignorance and hatred of improvement, is about as depressing a social picture as can be met with

EDWARD B. TYLOR

NILE GLEANINGS

Nile Gleanings. By Villiers Stuart of Dromana, M.P. (London John Murray, 1879.)

THE land of Egypt has of late caused the issue of a multitude of books, and that in consequence of the increased knowledge which half a century of Egyptian research has produced. Classical authorities no longer avail the traveller, he requires translations from the original hieroglyphic inscriptions, an insight into the discovery of a new world of antiquity and an acquaintance with the recent excavations which have revealed to the eye of the traveller an unveiled city of the dead. Scriptural texts alone garnished the older voyages Above all the accomplished traveller should be acquainted with the various sciences which enable him to detect what is new or salient in the country that he visits, and its development, political institutions, progress, or decay should be seen at a glance even if it demands pages to describe them. The grand Egyptian tour is however a promenade of the land of monuments. Mr Villiers Stuart's "Nile Gleanings" follow the usual track, and offer to the archæologist, besides the usual discussions on art, hieroglyphs, and language, and an occasional notice on the fauna and flora of Egypt, several new facts of archæological interest. At the description of Meidoum, the period of which is now known to be that of Senofrou, the tomb of Nofre Maat, with its strange figures inlaid with incrustations of red ochre, is new and interesting for its peculiar art and its remote age of the third dynasty; nor less important is the discovery of the flint flakes, the *débris* of the old chisels which sculptured it. Other tombs at the spot were remarkable for their gigantic masonry. These belong indeed to the more recent discoveries, but the traveller paid his respects to the dog mummy pits at Bebe, and the sites of Minieh and Dayr-el-Nakel. Considerable interest attaches to the heretical worshippers of the sun's disk, who flourished about the close of the eighteenth dynasty, and who endeavoured to remove the capital of Egypt from Thebes with "its hundred gates," to Tel-el-Amarna or Psinaula. The idea fashionable amongst Egyptologists has been that Amenophis III. of that line, the king, one of whose statues is the celebrated vocal Memnon, commenced an attempted religious reform and tried to substitute the worship of the sun's disk or orb, the Aten as it is called, for that of the god Amen-Ra, or the hidden sun. To this it is supposed that he was invited by the undue influence of his wife, Tai or Taiti After his death it is conjectured that he was succeeded by his brother, Amenophis IV, and that this Amenophis IV. was a convert of the most pronounced zeal for the worship of the solar orb or pure Sabæanism. For this purpose, from the Amenhepi, or the Peaceful Amen, he changed his name to Khuenaten, the Light or Spirit of the Sun. The chief data for this arrangement of the monarchs of the period of the eighteenth dynasty were the stones used for the construction of the Pylon or gateway of Haremhebi or Horus of the same dynasty, which were found to have been taken from an edifice of the so-called disk worshippers at Thebes, and built with their faces inside the wall, exhibiting the erasure of the name of Amenophis IV and the substitution of Khuenaten in the cartouches for Amenophis Some objections indeed might have been taken from the fact that the features of Amenophis and Khuenaten were different, it being of course facile to adopt a new faith, impossible to secure fresh features, even such unenviable ones as those of Khuenaten Mr Villiers Stuart discovered a new tomb at Thebes, with Amenophis IV and his queen on one side of the door and Khuenaten with his queen on the other, both dissimilar in features, arrangement, and condition—one perfect, the other mutilated. As both sovereigns could hardly have occupied the same sepulchre, evidently one of the two appropriated the construction of his predecessor The theory of Mr Villiers Stuart is that Khuenaten was a foreigner, which has been always asserted, although it is more difficult to decide to which of the races of mankind he belonged; there are however some reasons to believe that after all he may come from Nubia or the South. The discovery of this tomb is in fact the principal new point of the work, and is the one new and important contribution to the obscure history of the heretical division which took place about the thirteenth century B.C

The various sites of Esneh, Dendera, Assouan, Philæ, and the Nubian temples are well known, but are described in a light and graceful way, and much old material reproduced in a polished and not pedantic form. Necessarily a great deal is already well known to the student, and no inconsiderable portion to the general public. As to chronology the numerous systems and theories which have been started, amounting in all to above 200, allow any choice which suits best the proclivities of the inquirer. The present work has a new date for Rameses II., and throws his reign back to B.C. 1567, but it is difficult if not

impossible to reconcile a period so exalted with the ceiling of the so-called Memnonium and the date of the heliacal rising of the dog-star on the calendar of Thothmes III. at Elephantine. Every fact connected with the Exodus is a subject of continual dispute, dates, line of march, names of the Pharaohs, place of the House of Bondage whence the Jews swarmed out. The only safe view to take is that the problem is insoluble, and that its resolution should be tied up with the sheaf of paradoxes collected by De Morgan Mr Villiers Stuart found the cultivation of sugar prosperous, by means, though, of that apology for slavery "forced labour," and he is indignant at the sufferings of the unhappy fellaheen, as also at the urgent scheme of taxation and the system of baksheesh and official bribery which pervades the modern as extensively as it did the ancient land of bondage, but *corvées*, it appears, are necessary for the payment of Daira bonds, and "the drachm," as in the Roman times, must be wrung out of the hard hands of peasants While however glancing at the modern state of Egypt the interest of the writer is concentrated on the Egypt of the past, Pharaohs, their queens and their princesses, and a fair popular account is given of Thebes. His weakness is a love of dabbling in etymology, and venturing out of his depth on general questions of comparative philology. Although, for example, an occasional word may resemble its Greek or Latin equivalent, the construction of the hieroglyphic or old Egyptian and the Coptic is totally different from those two classical tongues, the Egyptian having a closer resemblance to the Semitic than the Aryan or Indo-Germanic languages As to the Etruscan, the few known facts about its construction point to the Turanian or Tartaric family rather than the Egyptian The origin of the Egyptians is still involved in obscurity, and belongs to the province of conjectural ethnology More Caucasian in the north and at the earliest period, more Nigritic on the south and at a later epoch, the Egyptians seem historically a mixed race, a fusion of conterminous races of Northern Africa, and Eastern foreigners, and Nigritic blood. The oldest inhabitants still remain a mystery. One theory is that the Egyptian was the primitive man of a vast continent, the last representative being the aboriginal Australian. Amongst other interesting points are visits to the Dervishes, especially the fortune-tellers, and a description of the ride of the Sheikh of the Saidieh over the bodies of living men, who must have suggested to the apostle, had he seen him, the subject of Death on the Pale Horse Like the car of Juggernaut, the Sheikh of the Saidieh is said to have been abolished. The ceremony might have been the relic of an old Egyptian one, and Pharaoh riding over his prostrate enemies may have anticipated the Sheik of the Saidieh. Altogether the work is entertaining and amusing, it is not so dry as a guide or handbook, nor so learned as an Egyptological history such as that of Brugsch-Bey, nor so elaborate as Wilkinson's Manners and Customs, and Topography, or other travels by professed Egyptologists; but its style is light and sparkling, and the principal details of history, mythology, and archæology have been fairly mastered. In the minute details of philology it is weak, but they do not affect the general reader, and are easily set right *en passant* by the expert. They will do no harm to scientific research, and they will amuse and to some extent instruct the public. The plates are also fairly done, and their colouring renders them more than usually attractive It is decidedly agreeable to while away the monotony of a voyage down the river of the desert, as the Nile may be justly styled, and to those whose only travels are round their room, it will convey some pleasing impressions of what a visit to Egypt might show them.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

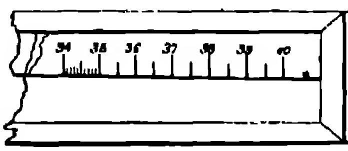
[*The Editor urgently requests correspondents to keep their letters as short as possible The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

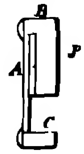
Improved Arrangement of Scale for Reflecting Instruments

THE inconvenience resulting from the position of the scale in the ordinary well-known form of Thomson's reflecting galvanometer must have been experienced by all who have had occasion to use it much, and especially by myoptic individuals. This I have been able to eliminate very easily, as hereafter described, so that there is no further craning over to see "the spot," or getting in one's "light" in so doing

The scale is mounted as shown in the sketch, which gives a front view of one end of the scale and a cross-section of the same.

B is a wooden scale-board with longitudinal slot, as shown at C, P is the paper scale, cut so that all the division lines reach the inferior edge, A is a slip of plane glass, finely ground as to its lower half on the side towards C, from one end of the slip to the other, the scale is so placed that the lower end of the division lines just touches the ground part of the glass slip. The image of the slit with a fine wire stretched across it is focussed in the ordinary manner on the ground part of the glass, and will of course be clearly seen by the observer on the opposite side of the scale, as the line and printed divisions are in the same plane, there is no parallax, and a great increase in accuracy of





reading the position of the hair line is obtained, owing to the greater ease of observing that two lines coincide when end on to one another than when superimposed, and further, from the circumstance that the room need not be darkened

This arrangement has been introduced at the beginning of this year by me in the testing-room of Messrs. Siemens Brothers and Co. at Woolwich, and has been most readily accepted by all my assistants, and I venture to say that any who adopt this arrangement will never return to the previous form.

I may state that I place the lamp and its slit on one side and reflect the beam of light on to the galvanometer by a mirror or total reflection prism, and further by means of two long plane mirrors reduce the actual distance between the galvanometer and scale, so as to have everything close to the observer's hand. The scale I have adopted is divided into half millimetres, and it is perfectly easy to read to a quarter of a division, and with a hand magnifying-glass still further.

This method is of course applicable to any physical instruments which are read by a reflected spot, and as there are no "patent rights" it is placed at the disposal of all.

Charlton F. JACOB

A Note on Flame-Length

THREE years ago, whilst endeavouring to make use of flame-length as a means of testing the economic values of different qualities of coal-gas by the determination of their specific flame-

lengths, I was led to the discovery of some simple relations, the further study of which will perhaps one day help to simplify the theory of flames. By specific flame length I mean the length of flame of a combustible gas burning in a normal atmosphere at a standard rate through a simple circular orifice under such conditions as to produce a symmetrical, vertical, steady flame capable of being measured. These conditions are not difficult to obtain in the case of coal gas. In fact for a very long time a flame-length test has been in use amongst gas makers, but as the comparison has not always been made on the basis of volume the results have not always been satisfactory The system I advocated was that of stating the flame-length for some standard rate It occurred to me at that time that the flame-length should be proportional to the consumption or rate of issue of the gas On submitting this theory to experiment I obtained satisfactory evidence that such was the case, as the following table taken at chance from a series of experiments will show :—

Flame length	Rate of consumption per hour	Calculated rate for 10″ flame
Inches.	Cubic feet	Cubic feet
2	·75	3·75
3	1·13	3 77
4	1 5	3 75
5	1 85	3 70
6	2·25	3 75
7	2 6	3 71
8	2 98	3·72

I have therefore formulated the following laws :—

1. That the flame length of a combustible gas is proportional to the consumption

2. That the flame-length is the distance travelled by a gas in obtaining oxygen for its consumption

3. That the flame-lengths of different gases are proportional to the relative amounts of oxygen required for their combustion.

The last remains to be proved, and I have been led to experiment upon simple gases such as hydrogen, carbonic oxide, and sulphuretted hydrogen, with the object of determining their specific flame-lengths, but these gases give flames offering great difficulties in measurement. The flames given by coal-gas under suitable and easily obtained conditions offer no difficulty, but I have not been able at present (owing to the difficulty mentioned above) to obtain very satisfactory results with the above-mentioned three simple gases. Other simple gases have suggested themselves, but the cost of preparing them in a state of purity in sufficient quantity has at present prevented their use However, with regard to sulphuretted hydrogen and carbonic oxide, I have found their flame lengths stand in the relation of 3·2 to 1.

In view of the difficulty of measuring the flames of these simple gases I am about to effect the determination by indirect means By preparing mixtures of known composition that will give easily-measurable flames, I hope to be able to throw some light upon this subject of flame-lengths.

March 22 LEWIS T. WRIGHT

Future Development of Electrical Appliances

As many of your readers have doubtless read Prof Perry's interesting paper on the future development of electrical appliances, a remark on one or two points might not be out of place. In speaking of the application of electricity to railway travelling, Prof Perry says that the weight of the train would be much reduced under the proposed conditions, and rail friction would be minimised It strikes us that to have light trains would not be altogether an advantage, for several reasons. The lighter the train the less profitable would be the *vis viva* against a strong wind (and the latter is an important element in railway locomotion). Again, the stability of a heavy carriage is much greater than that of a light one, and a heavy engine in front of the train must steady the whole system. It would be interesting to ascertain from a practical engineer whether a train of six coaches with self-propelling powers could safely run at a speed of fifty-eight miles an hour. GEORGE RAYLEIGH VICARS

Woodville House, Rugby

Prehistoric Europe

I AM sorry to have to ask you again to allow me to correct some statements made by Prof. Dawkins in the matter of the Victoria Cave explorations (NATURE, vol. xxiii. p. 482).

1. He says that "the antiquity of man in the Victoria Cave is solely due to the *perfervidum ingenium* of Mr. Tiddeman. It was first based on a fragment of fibula which ultimately turned out to belong to a bear. Then it was shifted to the cuts on two small bones." It is not, I believe, usual in the arena to hand over your own broken disabled weapon to your adversary to defend himself with when you take a new one. Yet this appears to be one of Prof. Dawkins's tactics. Who, reading the above remark, would believe that Prof. Dawkins ever held the following opinion? "Although the fragment [of the fibula] is very small, its comparison with the abnormal specimen in Prof. Busk's possession removes all doubt from my mind as to its having belonged to a man who was contemporary with the cave hyena and the other Pleistocene animals found in the Cave" ("Cave-Hunting," p 120.)

So far from the evidence having been "shifted" to the two small bones, on the breaking down of the fibula evidence, the latter event happened in 1878, whereas attention was called to the former in the Reports for 1875-6, the respective years of their discovery

2 "The bones are recent," says Prof. Dawkins. "This is evidently a very old bone," said Prof. Busk, after inspecting and experimenting on one of them submitted to him, and the whole of the circumstances of its discovery confirm that opinion.

3. "The cuts have been probably made by a metallic edge." That is a mere opinion, and to show what it is worth I may remark that at the discussion at the Anthropological Institute in 1877, when Prof. Dawkins stated that the marks looked as if they had been made with a Sheffield whittle, another member, at least equally distinguished, and apparently equally desirous to oppose the evidence, said that the marks seemed to have been made by a rock slipping across the bones

4. Prof Dawkins states that there were frequent slips of the materials after I took charge of the work He has, I think, been misinformed, for his own visits to the Cave during that period were not sufficiently frequent to warrant any such statement, and our endeavour was to work the Cave in such a method as would entirely prevent the possibility of such accidents and the mixture of the remains

5. Prof Dawkins goes on to show:—(1) Either that Dr. Geikie and I believe that "there is evidence of inter-glacial or pre-glacial man, possessed of domestic animals, and probably using edged tools of metals" (which we certainly do not); or that (2) in his opinion goat has never existed anywhere save as a domesticated animal, for his remarks proceed upon one or other of these two assumptions.

6. Bones of goat were far from uncommon in the hyena-bed of the Cave, and found under such circumstances as would render their slipping down from higher beds quite impossible. The same is the experience of that distinguished explorer, M. E Dupont, Director of the Geological Survey of Belgium, in the caves of that country :—"J'en maintiens absolument la co-existence avec ces espèces perdues" (*Journ* Anthropol Inst., vol. vii, No. 2, p 168). Unfortunately the non-existence of goats in Pleistocene deposits in Great Britain has been elevated to a dogma, and when the animals are found in such association it is immediately assumed that they have slipped from above—a confession to a very slipshod method of working—or, that the beds have previously been disturbed. All such cases should be most carefully inquired into and observed at the time without prejudice.

7. Again, Prof. Dawkins says that I wrote that the fact of the finding of reindeer with the earlier Pleistocene animals was "noteworthy," and that it is now too late to recall it. I do not recall my statement, but I should like it quoted correctly. "Your reporter had an impression that the reindeer remains occurred at some height above the hyena-bed.[1] Be that as it may, Prof. Dawkins's opinion[2] is entitled to great weight, and is indeed the view generally held. At the same time, considering that hyena and reindeer are not uncommonly found together in caves, when, as in this case, we see them mixed together at one or both ends of a section, but separated through an interval of seventy feet in length by a thickness of deposits, we may regard the fact as at least an interesting one, and, when found, noteworthy" (Brit. Assoc. Reports, 1876, p. 118). Prof. Dawkins shall have the whole of that. I will not recall even the middle sentence. R. H. TIDDEMAN

Hastings, March 26

[1] "This was also the opinion of Mr. Jackson, our painstaking superintendent, who was daily in the Cave

[2] *i e.*, of the co-existence of these animals

Induction Current from Leyden-jar Discharge

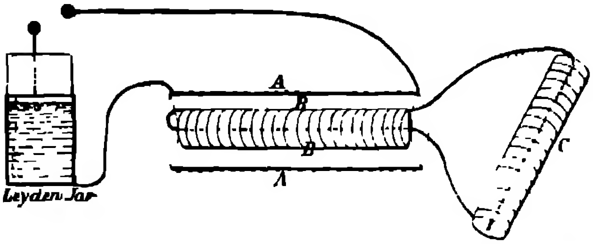
I WAS led to try the following simple experiments with the current induced from Leyden jar discharge, from the knowledge of what is the case in the Ruhmkorf's coil induced currents.

I have since found the experiments have often been tried before; but all may not be aware how simply and easily the results are shown.

After trying flat coils I found it more convenient to coil stout insulated wire round glass tubes. A few yards of stout wire round a tube A one foot long and 1½ inches diameter gave me my primary coil, a similar tube B of less diameter to put inside A formed my secondary; and a third coil C enabled me to examine the current induced in B, with respect to its magnetising power, at a distance, away from the influence of the primary A. An electrical machine, a Leyden jar or two, a number of un magnetised knitting-needles marked with paper at one end, and a compass needle to test polarity, are also required.

The experiments are as follows:—

(1) With coil A alone show that a needle is magnetised according to Ampère's law; if we regard the direction of current to be from the + coat of the jar to the − coat.



(2) Now arrange the coils as shown, A as primary, B as secondary, C in the circuit of B, and a needle in C. Let there be *no* break in the circuit of B and C.

Then the magnetism induced in knitting-needle shows by (1) an action as of a current *inverse* to that in A.

(3) Now interpose a break in circuit of B and C, so that induced current gives a spark. We now get the needle oppositely magnetised, showing a direct induced current, and the magnetisation is *far stronger* than in (2).

This points to the two opposite induced currents both passing when there is no air-break; and the inverse having the strongest magnetising action, but the result weak. An air-break stops the inverse current, and the far greater effect of the direct current un-neutralised by the inverse is very marked; it can easily be shown to a class, for example.

I may add that I have been unable to try what results one gets with galvanometers from lack of instruments.

Cheltenham W. LARDEN

Classification of the Indo-Chinese and Oceanic Races

IT is surprising that Mr. Murton should have had any difficulty about the characters used by me to indicate the word *Papûwah*. The form in question is identical with his own, the apparent difference being due to the two different characters respectively employed by us to express the labial *p*. In the Arabic alphabet there is no sign for this letter, because the sound does not occur in the Arabic phonetic system. Hence other Muhammadan nations using the Arabic alphabet supply the missing letter in various ways, the Persians, Afghans, and Indians by the form پ, the Malays usually by ڤ. Hence the two apparently different but really identical forms پپوه and ڤڤوه which have puzzled Mr. Murton and his Malays of Singapore.

A. H. KEANE.

Crabs and Actinia

THE account of the actinia on the claws of a crab in your last number (p. 515) is of interest as raising the point as to what benefit the crab derives from its friends. In the *Annals of Natural History*, many years ago, I wrote that, having for a long period kept *Adamsia palliata* with *P. Prideauxii* in confinement, I had no doubt but that the white tentacles of the anemone were a bait which attracted various small animals within reach of the crab's claws, though it did not, as Mobius seems to think, in any way aid the crab in capturing its prey.

In the South Sea Islands I saw a splendid specimen of a crab carrying a large actinia. The habit of the crab was to conceal itself entirely in the sand, leaving the actinia waving its tentacles on the surface. No sooner however did a small crab, annelid, or other creature come within reach than the crab, shooting its claw out of its concealment in the sand, struck out, and in most cases captured it. Here there was no doubt of the use of the actinia as a decoy.

H. STUART WORTLEY

Patent Office Museum, South Kensington, W., April 4

Migration of the Wagtail

WITH reference to the statement of Herr Adolf Ebeling (*apud* the correspondence from the New York *Evening Post*, quoted in your issue of February 24, vol. xxiii. p. 387), that the fact that wagtails in their wintering "came to Africa, and especially to Nubia and Abyssinia, was then unknown to us," permit the remark that as "*then*" must refer to a date not earlier than 1850 (when Heuglin went to Egypt), the appearance of wagtails on the west coast of Africa, as far south as Cape Verd, had been observed more than half a century before.

In the *Annales de Chimie* for July, 1793, M. Prélong, one of the lieutenants of Stanislas, Chevalier de Boufflers, and director of the hospital at Gorée, records the arrival on September 14, 1788, of a flight of *bergeronnettes* from the north. In connection with this M. Prélong remembered that Adanson had seen swallows at Senegal October 9, 1750 (?), while he himself could testify to their leaving his native *pays* (the Hautes-Alpes) towards the end of September. Prélong took ship for home in the middle of May, 1789, and was accompanied by his feathered friends the wagtails.

N. J.

New York, March 15

Sound of the Aurora

UPON this subject it may not be out of place to recall the fact that the passage of large meteors is not uncommonly described as accompanied by a hissing sound. I have met with statements of this kind in the case of meteors which were proved to have been twenty, thirty, or forty miles distant from the observer, and the sound of which, therefore, if it had reached him at all, must have reached him after such an interval of time that he would have been very unlikely to connect the two phenomena. Moreover the sound described in these cases is of a totally different character from the true sound of meteors, which is spoken of by those who have heard it as a heavy roaring or rumbling sound.

The explanation of the alleged "hissing" is not difficult when we remember that the untrained observer of a bright meteor (although it may be distant fifty or a hundred miles from him) invariably regards it as a near object, falling, it may be, into the next field, or behind a neighbouring hill. Regarding it in this light, he attributes to it, by a well known mental process, a sound such as a firework at the same distance might be expected to produce.

May not the "rustling" of the aurora be equally a subjective phenomenon?

GEORGE F. BURDER

Earthquake Warnings

IN *Comptes rendus*, lxxxi. October, 1875, I find it stated, on the authority of M. Rivet, Telegraph Superintendent at Fort de France, Martinique, that when that island was visited by repeated earthquake shocks in September, 1875, each shock was preceded by a very marked disturbance of the electric telegraph needles. M. Rivet suggested that in this way warnings otherwise unattainable of impending shocks might be obtained.

It would be interesting to learn whether this observation has been confirmed by recent experience on the Continent.

Such warnings might often be the means of averting loss of life and property, and in cases like that at Ischia would, by their occurrence or non-occurrence, afford some additional clue to the real nature of the forces at work.

H. M. C.

Charlton, March 31

ON THE EARTHQUAKES AT AGRAM IN 1880-81

[At our request Prof. Szabo, Professor of Geology and Mineralogy in the University of Budapest, has prepared for the pages of NATURE the following account of the recent earthquakes at Agram. This account is a thoroughly reliable one, as it is drawn up from information obtained from Dr. von Hantken, the Director of the Hungarian Geological Survey, and Mr. Schafarrik (Prof Szabo's assistant), both of whom were officially deputed to visit the district and inquire into the whole of the facts.]

On November 9, 1880, at 7h 33m. 53s, a very violent earthquake passed over the south-western quarter of Hungary and also Bosnia and Herzegovina. The limits of this large territory are approximately as follows:—West, the peninsula of Istria and the town of Trieste; north, Vienna and Gödöllö (north-east from Budapest); east, the flat lands between the Danube and the Theiss; and south it reached far beyond Serajewo, because the earthquake was felt in this town also very strongly. It is said by some that the earthquake was even observed in Budweis (in Bohemia) and in Debreczen (east-north-east from Budapest). This territory is approximately equal to a circle, the radius of which is forty geographical miles long, and therefore its area is nearly 5000 square miles. From all information received up to the present time it may be asserted that the earthquake was not equally felt over the whole territory, but mostly in the centre of the circle—in the environs of Agram, where the damage occasioned was considerable.

According to the testimony of trusty witnesses the earthquake began on the day mentioned above with a strong shock in an upward direction, which was accompanied simultaneously with a perceptible and loud subterranean noise; this was followed by a subsidence, then came a perpendicular shock from below; and lastly came an oscillatory movement of the earth in an east-south-east to west-north-west-direction. This movement, which lasted nearly ten seconds, was so intense that in the town of Agram not only all the larger public buildings, but with few exceptions every dwelling-house, was damaged more or less.

One peculiarity of this first shock is that not only were objects of small weight removed out of their original positions, and this was especially the case with objects standing on a flat surface, but it also produced a certain rotatory motion upon them (contrary to the hand of a watch), even some trustworthy witnesses affirm that the first shock had a rotatory effect on them

Chimneys are the objects which are the most easily damaged by earthquakes, and so in Agram there was scarcely a chimney to be seen after the earthquake which had not been either cracked or entirely ruined. The number of fallen chimneys amounts to nearly a thousand. An enormous amount of damage was also done to the roofs of houses; one could see from the roof-tiles placed on laths that they had been shaken by the oscillation, and were partially broken and fallen down, especially those which were situated towards the east or west. All this happened in the morning when the streets were mostly crowded with people, and one must be astonished indeed that the great quantity of falling masonry, parts of walls, stone cornices, huge beams of wood, and pieces of broken glasses, &c, did not hurt more people; altogether only twelve were severely wounded (broken arms, hands, feet, head wounds, &c.), but only in two cases did the injuries prove fatal, about twenty suffered slight contusions. In the surrounding country three men died, and some suffered from various injuries.

Among the public buildings and the larger dwelling-houses in Agram not one has actually fallen to ruin, but the number of those houses, whose outward walls were obliged to be supported by long beams on every side, is considerable, much more terrible, however, is the view of destruction inside the buildings; the mortar from the walls of the rooms is for the greatest part fallen down, and the thinner walls have been shaken so much that some of them are totally fallen to ruin. About twelve buildings were so ruined by the earthquake that it was necessary to forbid their reconstruction, and the Senate of the town found itself compelled to order their entire demolition. Here is the corner house belonging to Mr. Priester, with two storeys facing the Marie-Valerie Street and Jellacsics Square, whose western frontal wall has separated itself from the other parts of the house, and is entirely bent towards the Marie-Valerie Street; the house of Mrs Zorgách in the Petrijani Street is ruined and must be demolished; the building of the Military Academy in Ujlak has been a real and sad ruin. In the upper part of the town the following edifices are designated to be demolished.—Br Ozegovich's house, the Mednyanszka Barracks, a certain part of the military "General-Commando" building, &c. The number of those buildings which have been rendered uninhabitable by the earthquake is great, but with great difficulty—by using iron braces—they can be renewed. To these buildings belong the cathedral, which is erected in the broad square courtyard of the archbishop's palace. In this cathedral the vault of the sanctuary has fallen in and has covered the high altar and the space before it with fragments of wall and rubbish; further, a part of the vault just before the organ and a little to the right of the entrance has fallen down in the centre nave, in the side nave a very heavy horizontally-placed buttress split, fell down, and broke through the tombs where the coffin of a canon was; besides these more striking damages the main wall was split in several parts. The archbishop's palace itself has been damaged to such an extent that the archbishop and the canons were obliged to leave their apartments for a long time In the same manner the Franciscan and St. Mark's Churches were also damaged. One can also add among the others St Catharine's Church, which has been sadly damaged, as also the edifices of the University and of the "Real-schule," and many other private houses. The high chimneys of the gas-factory and of Grator's brick-kiln were only partially damaged at the upper part.

After these come those houses which, though they were very greatly damaged, yet the people were not obliged to quit them; and lastly follows the great number of those buildings which sustained only smaller damages (for instance, little rifts near the windows or along the corners of the walls, through mortar, &c, falling down). The proportion between the number of the edifices which became uninhabitable and had to be demolished, in comparison with those which were damaged in a greater degree and those which were slightly damaged, is about 1 : 1 : 4. This arithmetical proportion nevertheless cannot at all express the damage that happened, because among the two first categories are the most valuable buildings, viz the churches, barracks, the largest and newest houses, while the mass of the third category consists of small low buildings; one must attend to the above descriptions because it is impossible to set strict bounds between the single categories, for there were many houses whose ground-floors were totally free from chinks, the first- and second-floors already showed gradually more chinks in the walls, while the third-floor presented a terrible picture of destruction. The damage to edifices caused by earthquakes depends on their solidity, on their height, and on their situation. As regards the solidity, they found that the weaker the walls were, and where iron braces were not applied, the more were the buildings damaged; as regards the height, on the occasion of this earthquake it was observed that the second-floor was more damaged than the first, and the third more than the second; and finally as to the situation,

there are some remarkable examples, houses forming south-east and north-west corners were exceedingly damaged, viz. south-east was the direction where the first shock came from.

In the environs of Agram the earthquake appeared with no less strength than in the town itself, but the damage to the surrounding country is not so general, because here are the peasants' cottages all built of wood. Here therefore only the churches, the parsons' houses, schools, castles, and gentlemen's private houses were the objects on which the earthquake left visible marks.

All the buildings of any strength in the villages which are situated at the south-east slope of the mountain called Sleme, north from Agram, were damaged in a more or in a less degree; there is for instance the well-known place for pilgrimages, Remete (5 km. north of Agram), where the walls of the church, which is ornamented inwardly with very beautiful frescoes, and of the steeple are strongly gaped in all directions, while the vaulted roof of the nave is totally fallen down; so is also the residence of the parson, the damage caused in these two edifices amounts, according to an official valuation, to 38,000 florins. In Grancsina (7 km north-east from Agram) the steeple, falling down in an easterly direction, broke through the roof and the vault of the church, so that now one can see only the four very ruptured walls On the other side of the mountain Sleme, in a certain part of Croatia named Zagoria, many castles were ruined

The circle, where the earthquake caused the heaviest losses has approximately the following bounds .—South-west, Karlstadt, west, Landstrass, Gurkfeld; north-north west, Robitsch, north, Warasdin, Csáktornya; north-east, Kaproncza (Kopreinitz); east, Belovár; south-east, Sziszek, which corresponds to a territory of about 120 square miles, the centre of this circle was the place where the first shock emanated from The data kept in the surrounding parts relative to the direction and the greatest intensity of the shock indicate the territory which lies to south-east from Agram, and forms the alluvium of the River Save as the starting-point of the whole phenomenon. Here the crevice in the earth appeared also, caused by the strongly-oscillated motion. A little to the east from the village of Resnik (east-south-east from Agram) was the crevice in the alluvium of the Save It was 5 kilometres long, and had several interruptions, and extended in a south-east direction, from which here and there some smaller crevices radiated. This chief crevice, which continued through the Save as far as the village of Scitarjevo, showed in some places a few days after the earthquake openings one to two feet broad, but for the most part the crevice was filled with bluish alluvial sand, which was forced out, mixed with water by the opening and closing of the crevice being formed by the oscillation of the soil, the water forcing its way through this dense pulp, produced by its upheaval those small flat craters which many people are inclined to declare volcanoes of mud The dimension of these small craters is very variable; their diameters differ between 2 and 75 c m., their height 1 to 30 c.m., and, calculating from these numbers the cubic contents of the largest flat cone, we receive nearly 0 5 cubic metres; this little quantity of the out-pressed material is enough to exclude the hypothesis that these cones were the result "of a slow action for some hours" If hydro-sulphuric gas was present during this phenomenon, as some believe, it is not known, because we want positive and trusty evidence on this point. Moreover it is not impossible that there should be an appearance of small quantities of hydrosulphuric gas dissolved in the water of an alluvial slimy soil, because such water generally contains decaying substances and finely-dispersed sulphates, but one can in no case suppose that a great quantity of hydrosulphuric gas would have produced the crevices and ejected the sand mixed with water.

Beyond this territory of 120 square miles the earthquake was felt with a gradually diminishing strength, and in many places the motion was so weak that a great many of the inhabitants did not remark it. Among these can be mentioned Fiume, where they felt only a very slight shock, then Budapest and Vienna, where only one or two became attentive to this phenomenon.

Beyond the territory of 120 square miles, where they suffered the strongest shocks, there are yet some environs, though far enough from the centre, where destruction also happened, for instance in Styria, and in Hungary, in the neighbourhood of Pécs (Funfkirchen) To explain the connection of these cases with the entire phenomenon deeper researches must be made.

It remains to communicate shortly the statics of the earthquake.

1. November 9, at 7h. 33m. 53s. in the morning, the first shock enduring 10 seconds with a subterranean noise. This one has caused all the damage.

2 November 9, at 7h. 37m. in the morning: an oscillatory motion without a noise

3 November 9, at 8h. 27m. 55s in the morning: slight motion

4. November 9, at 10h 50m. in the evening: very slight motion

5 November 10, at 6h. in the morning very slight motion.

6 November 11, at 11h 26m. in the forenoon. a strong oscillation, which effected some damage.

7. November 16, at 12h 4m. in the morning: a sufficiently strong shock accompanied with a dull noise.

8 November 16, at 12h. 44m.
9. „ „ 12h. 49m.
10. „ „ 1h 9m.
11 „ „ 4h. 24m.
in the morning.

weak oscillations, of which only the last had a little more strength than the others.

So it lasted continually during December. Even in this year (1881) in January and February feeble shocks recurred after longer interruptions; the last shock was recorded in the newspapers from March 4

Budapest, March 18

THE ST. PETERSBURG DYNAMITE MINE

THE following account of the mine recently discovered in St Petersburg, extracted from Russian sources, gives a remarkable picture of the state of society in the empire, where able chemists and expert miners can be found to engage in such desperate undertakings

It appears from a sketch-plan which accompanied the translation put into our hands, that the mine extended from one side of Malaya Sadobaya Street to the centre of the roadway, the total length of the mine gallery being fifteen paces, the street must be thirty paces, say seventy-five feet wide

The gallery terminated in a chamber about double its diameter, and in this was found the charge contained in a case twenty-two inches long and eight inches diameter, weighing sixty-five pounds, and beside this a glass jar contained about thirty pounds more of the explosive substance, apparently an excess quantity over that required for the actual explosion The explosive consisted of a species of dynamite made by mixing nitro-glycerine with powdered charcoal. This is more powerful in its effects than the ordinary substance, in which an inert body, generally a soft infusorial earth, takes the place of the charcoal. The description of the fuse, as contained in the Russian account, is very obscure, but so far as can be made out it would appear to have consisted of a wide heavy glass tube containing an explosive, described some time back in NATURE, and prepared by mixing nitro-glycerine with about 10 per cent. of gun-cotton, the result being a very explosive substance of a partially gelatinous character. In the midst of this, and

surrounded by a mixture of potassic chlorate and antimonious sulphide, was a sealed glass tube containing concentrated sulphuric acid and a leaden weight The whole was then apparently connected with the dynamite in the case by means of an india-rubber tube also containing explosives. If this was the actual construction the *modus operandi* of the conspirators was very simple, for the heavy glass tube had only to be allowed to fall, when the lead would have broken the sulphuric acid tube, and the chlorate mixture would have at once inflamed, and the explosion of the jelly would have communicated by means of the rubber tube with the torpedo At the same time it is very difficult to imagine the reasons which could have induced the conspirators to adopt so crude a method when, as it appears from the account, they had at their disposal in the room adjoining that from which the mine was driven no less than four galvanic batteries, with which the explosion could have easily been instantaneously effected by those on the watch for the passage of the intended victims, a method of operation much more consonant with the skilled character of the other parts of the work It is however very difficult to understand a description such as this when derived from a non-scientific source, as may be imagined when one of our daily contemporaries stated that the fuse contained "*bartholley salts*," and another "chlorate of potash and *sulphide of ammonium*"

Whatever may have been the real mode intended to have been used by the conspirators, the results would have been sufficiently frightful, as it is probable that the charge found would have made a "crater" of about fifty feet in diameter.

The jelly contained in the glass tube was, when analysed, found to contain about 4 per cent of camphor This was added to render the mass less sensitive to any accidental shock which it might incur, and is an ingenious application of principles laid down by Abel (*Proc.* Roy Soc xxii p 163) in his well-known paper on "The History of Explosive Compounds," in which, though not actually mentioning the dilution of a liquid or semi-liquid explosive by the solution in it of another body, he clearly indicates the probable effects of such a treatment That men of education and ability should so apply their undoubted powers must be a matter of regret to every student of science.

FISH-CULTURE IN THE UNITED STATES

IT is a common saying that everything in America is on a larger scale than in this country The longest rivers, the largest lakes, the highest mountains, the broadest plains, the most stupendous waterfalls, and the biggest hotels, are all to be found in the New World Fortunes are made with a rapidity which is unparalleled in Europe; and men who only lately were penniless adventurers are losing or winning millions in New York. The latest example of the scale on which everything in America is conducted may be found in a volume of more than 1000 pages, printed in the Government printing-office, bound in the Government "bindery" of the United States, and containing the Annual Report of the United States Commission on Fish and Fisheries. The volume, it may be added, has been preceded by five others of almost equal length; and gives a remarkable idea of the importance which the Americans attach to fish-culture.

It would obviously be impossible to attempt, within the compass of a newspaper article, any adequate review of a work of this character But we may perhaps indicate its nature by rapidly describing its contents. The volume, then, is roughly divisible into two parts. The first 64 pages contain the Report of the Commission; the last 988 pages are occupied with appendices and an index. Forty-four appendices of unequal importance are thus published The greater portion of them consists of translations or reproductions of papers published in other countries and having more or less reference to the work of the Commission. For instance, there is a report by Herr Wallem (the well-known Norwegian Inspector of Fisheries) on the American Fsheries, by Prof. Sars on the Norwegian Deep-sea Expedition of 1878; by Mr. Stirling of Edinburgh on the Recent Outbreak of Salmon Disease; and by other authorities on various subjects In addition the appendices contain original papers by Messrs. Livingston Stone, C G. Atkins, and other American fish-culturists on matters more or less connected with fish-culture in the United States Thus the volume undoubtedly contains a vast mass of information. Much of it indeed is written in a style which in this country would be considered more suitable to a review than to an official report But the American system of government is so different from our own that an Englishman cannot easily form an impartial opinion on this point

Herr Wallem estimates the yearly profit, by which we think he means the gross yield, of the fisheries of the United States at 27,300,000 dollars. In this sum is "naturally not included what foreign nations capture on the banks of America, nor what the fisheries of Canada yield If one should take both these factors into the calculation the amount mentioned may perhaps be increased by one half, because the French fisheries alone on the Newfoundland Islands have a yearly profit of \$1,365,000 to \$1,638,000, and the Canadian fisheries yield \$10,920,000 to \$12,285,000 yearly" Herr Wallem adds in a note that "for comparison it may perhaps be instructive to state that the Norwegian Marine Fisheries may be estimated at \$12,285,000 to \$13,650,000 yearly, and the French at \$15,015,000 to \$16,380,000." If these figures may be accepted as correct on the high authority of Herr Wallem, the American fisheries must be worth about 5,500,000*l* a year, the French fisheries 3,250,000*l.*, the Norwegian fisheries 2,600,000*l*, and the Canadian fisheries 2,250,000*l* We have unfortunately no statistics at our command which would enable us to compare these values with the produce of our own fisheries, but we do not believe that any competent authority would place their value at less than 6,300,000*l*; and we believe that most persons would be disposed to name a higher sum. Englishmen, therefore, may have the satisfaction of reflecting that the fisheries of the British Islands are still the most important in the world; though the fishermen of the United States are fast overtaking British fishermen

Those persons who are most familiar with the British fisheries are aware that for years past complaints have been made of the injury done both to fish and fishermen by the operations of trawling. It is very singular that trawling is also objected to in the United States; and the Commissioners print in their appendices a petition from the fishermen of Block Island on the subject But the similarity between the complaints disappears on examination A trawl in England is a large purse-net, attached to a heavy beam raised upon trawl heads or irons at either end, and dragged along the bottom of the sea. A trawl in Scotland is simply a draft or seine-net; a trawl in America is a long line baited with hooks and left on the bottom of the sea. It is very odd that these three distinct modes of fishing are all objected to in the different countries in which they are employed. In Scotland the drift-net fishermen object to the trawl or seine-nets, in England the drift-net fishermen and the line fishermen object to the beam trawls. In America the hand-line fishermen object to the set-line fishermen, whom they call trawlers. Among the fishermen of the three countries there is a cry against trawling, and the fishermen of the three countries are all alluding to distinct modes of fishing. These complaints may, centuries

hence, puzzle some antiquarians, who may naturally assume that these races, speaking the same language, mean the same thing by the same word. They all are due to the jealousy usually felt by the introduction of new machinery in any industry. The set-line fishermen, who complain of the beam trawls in this country, form the very class which the hand-line fishermen complain of in America under the name of trawlers, and the Governments of both countries may safely disregard both complaints, since one of them is the most effective answer to the other.

We have reserved for the close of this article all reference to what the Commissioners would consider the most important portion of their Report. The Americans are the greatest fish-breeders in the world, and fish-breeding is conducted in the United States at a cost and to an extent of which in this country we can have little idea. According to the Report, the Commissioners distributed in 1878 no less than 15,700,000 shad and 4,460,000 Californian salmon, besides other fish. Such prodigious efforts will excite surprise among persons who are acquainted with the difficulties of obtaining even a few thousand ripe salmon eggs, and we naturally turn for information as to the results which have ensued from such unprecedented efforts. Here however we find, as it seems to us, the least satisfactory portion of the Report. The Commissioners claim indeed that no less than 500 salmon were taken in the mouth of the Connecticut River in 1878, a river which they imply had had few or no salmon in it for many years. It is possible therefore that the Commissioners' efforts may have been successful in restocking that river with salmon, though we own that we should feel more certain of this if the fish had been taken in the river itself, and not in the mouth of it. But when they go on to infer that they may increase the yield of shad, and even of herring and of cod, we read with admiration of their energy, but without being convinced by their reasoning. In this country, at any rate, the best observers are satisfied that cod, herring, and other fish are annually bred in numbers compared with which the fifteen millions of fry of the United States Commission would represent an insignificant fraction, and that the destruction which is going on among them by natural causes is so vast that even the capture of white bait by the ton-load makes no appreciable addition to it. The arguments which Malthus, at the commencement of the century, used to illustrate the principles of population are thought in this country to be strictly applicable to fish. Sea-fish, like all other animals, are undoubtedly increasing in greater proportion than their food; and it is obvious therefore that unless man can increase their food it is only lost labour to increase their number.

We have thus reviewed, at some length, a few of the leading facts in this long and interesting Report. With many of the conclusions in it we are unable to agree; but we cannot part from it without expressing a feeling of almost envy at the elaborate pains which the Government of the United States is taking to understand the best methods of developing the great industries of their seas. In this country we do not even take steps to obtain the best statistical information on the subject. Might we not in such a matter with advantage follow the example of our Transatlantic kinsmen?

THE PARIS OBSERVATORY[1]

ABOUT two years ago Rear-Admiral Mouchez, director of the Paris Observatory, resolved to bring together for exhibition the instruments scattered in various parts, and by joining to that collection the portraits of great astronomers and methodically grouping all the documents relating to the history of astronomy which could be procured by bequest or otherwise, to lay the basis of a special museum of very great interest. This proposal, having received the approval of the Minister of Public Instruction, is now being realised. One of the large rooms on the first floor of the Observatory has already been fitted up and occupied, and through the kindness of Admiral Mouchez, who himself did us the honour of giving full details of his new collection, we are able to publish the description.

[1] From an article by M. Gaston Tissandier in *La Nature*, and M. Mouchez's official Report of 1880.

The first hall of the Astronomical Museum is very artistically decorated. It is circular in form, and well lighted by several windows. The ceiling will probably be adorned by a painting representing the transit of Venus over the Sun. There are nine paintings in the room, representing Louis XIV, founder of the Observatory, and directors and eminent astronomers who have

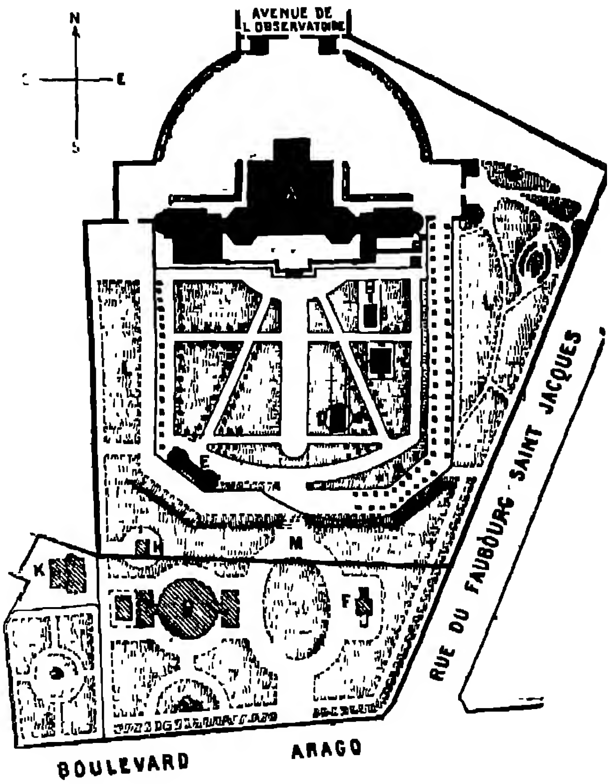


FIG. 1.—Plan of the Observatory, with the proposed extension on the south side to the Boulevard Arago. Present state: A, the Observatory; B, the "sidérostat;" C, the meridian circle; D, the great telescope; E, equatorials; M, ditch to be filled up; L L, ditches. Ground to be annexed; F, the Bischoffsheim equatorial; G, the great refractor of 0·74m. aperture; H, Fortin's circle; K, the astronomers' dwelling-house.

succeeded each other to the present day. Cassini, Lalande, Delambre, Laplace, Bouvard, Arago, Delaunay, and Leverrier; the latter painted after death by Giacomotti, is the gift of M. Bischoffsheim. In the embrasures of the windows are displayed astronomical paintings representing groups of nebulæ, Saturn's rings, lunar volcanoes, clusters of stars, the remarkable drawings of Jupiter and Mars executed by MM. Henry, &c.

On the oak mantelpiece stands a magnificent Louis-Quatorze clock made by Coypel and recently restored by M. Passerat, a specimen of art so unique that virtuosos would certainly attach a great value to it. Round the room are observed several globes mounted on marble and oak pillars, two being especially worthy of attention: the celestial sphere of Gerard Mercator (1551), and the terrestrial sphere of the same geographer (1541). On the latter globe may be seen figured a certain number of the great lakes of Central Africa already known and their

positions well indicated in the middle of the sixteenth century. These spheres, which constitute documents of great importance historically, were recently discovered at the Brussels library through a folio pamphlet bought in 1868, and have been reproduced with great accuracy, by M. Malou.

The objects exhibited are carefully classified in glass cases, so that they can be examined by the visitor without being touched. In the first case, which is set apart for optical instruments, is observed Fresnel's great lens, also some of the object-glasses made use of by Cassini, and other valuable objects presented to the Observatory by Mme. Laugier, such as the optical apparatus made use of by Arago; the photometer, prismatic mirrors, and the polarimeter, by means of which the great astronomer enriched science with so many beautiful discoveries

The second case contains objects relating to the history of the "metric system," comprising a standard metre and several curious specimens of foreign measures. The other glass cases, arranged in a circle round the room, contain various astronomical instruments, among which we may mention the apparatus made use of by M. Cornu to measure the velocity of rays of light, a large theodolite of Rigaud, another of Bruner, one of the first sextants ever constructed; also several instruments of more modern date, the first portable meridian circle of M. Mouchez, Gambey's theodolite, &c.

The case in the centre of the room is especially

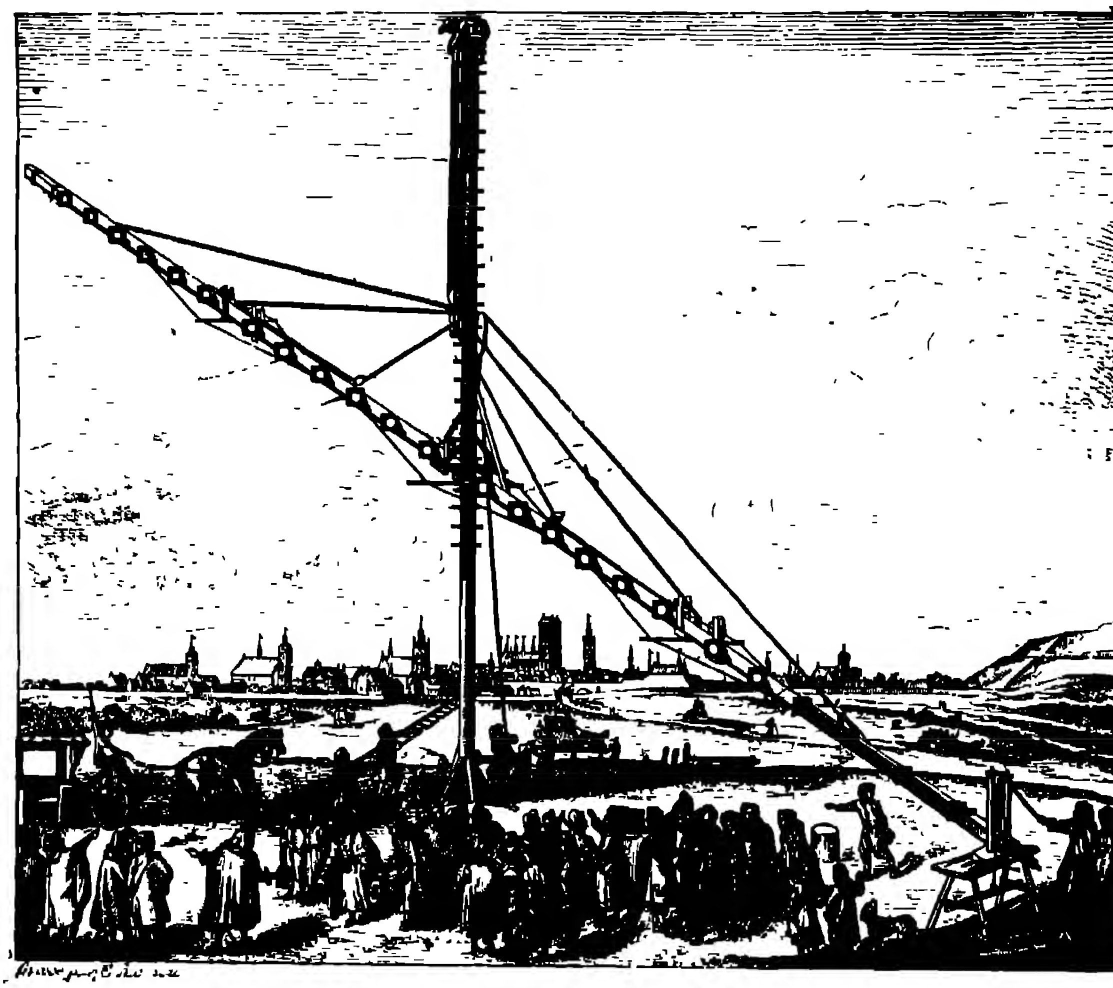


FIG. 2.—Aerial telescope of the seventeenth century, after Hevelius, from an engraving in the new Astronomical Museum of the Observatory of Paris.

noticeable: it contains a curious collection of German instruments of the sixteenth century, in perfect preservation. The attention is at once attracted by several instruments of gilt brass, most artistically carved, which were made at Nuremberg in the sixteenth century. Amongst them we observed a curious mechanical arrangement for casting dice, which was probably used for some demonstration of the doctrine of probability and chances; a valuable sun-dial of carved brass, dated 1578, full of groups of allegorical personages; a species of altazimuth, a handsome repeating-circle, highly ornamented, and bearing the two-headed eagle of Germany; some astrolabes, quadrants, mariner's-compasses, a small ivory sun-dial of the sixteenth century, presented by M. Eichens. The history of all these instruments except the last is unknown; but it is supposed that they were either presented to Louis XIV. or are what is left from the spoil of the First Empire having escaped the notice of the Allies in 1815.

On the lower part of this case are shown photographs of old engravings representing the astronomical instruments of former ages. One of those curious pictures is reproduced above (Fig. 2), showing the astronomical telescope with a simple object-glass of long focus which was constructed in the seventeenth century, and of which an engraving was published by Hevelius. It may serve to convey an idea of the singular and gigantic instruments which astronomers of bygone times made use of.

In a room on the floor above there is a special exhibition of a large number of photographs, which is being constantly increased by new additions. They consist of photographs of all the ancient instruments copied from engravings of the period; and all the foreign instruments in present use, taken from nature. There are also drawings representing the principal observatories in the world.

Such is the commencement of the astronomical museum of the Paris Observatory. It will be completed by organising a second circular room resembling that which we have just rapidly passed under review. This new room will be adorned with portraits of the most illustrious of foreign astronomers—Newton, Galileo, Tycho-Brahe, Kepler, Copernicus, Herschel, Bradley, and others. It will also contain a special exhibition of large astronomical instruments; notably a quadrant of Lalande's, a sextant of Lacaille's, a quadrant of Langlois' which was used by the North Pole Committee, and a meridian telescope of Delambre.

It would be useful to bring together in the Paris Observatory those instruments which are scattered here and there in various other national institutions, so as to complete a collection already so rich in valuable objects. The directors will also gratefully accept of any bequests that may be addressed to them from private individuals, as was done by Mme. Laugier with reference to the instruments of Arago and Delambre which she had in her possession.

After our survey of the new Astronomical Museum, it now remains to say a few words regarding the extension of the observatory, which is about to be made by annexing the ground on the Boulevard Arago (Fig. 1). This waste land contains a superficies of at least 9000 metres, and when the ditch which at present divides it from the Observatory garden is filled up, it will be united to the rest of the institution without any separation. On these grounds will be erected the great 75 m. telescope, the arrangements for which are already well advanced; also the equatorial presented by M. Bischoffsheim, the circle of Fortin, which long rendered excellent service, and was dismounted in 1862 to make room for the the great meridian-circle, and several instruments for the special use of the pupils.

The plan which we give above (Fig. 1), from official documents, shows what the Paris Observatory will be as a whole when the projected improvements are completed.

We regret that the works are being so slowly carried on, notwithstanding the praiseworthy energy evinced by the directors of the Observatory. A ditch to be filled in, a garden to be laid out, a few buildings to be erected, all amount to but very little. But before the masons cut a stone or the gardeners trace an alley there is a path to be traversed which is not exactly the shortest or quickest, viz. that of administrative and official routine.

ACHILLE DELESSE

WE regret to have to record the death of this eminent geologist, which took place, after a long illness, on March 24. Delesse was born at Metz, and was educated at the lyceum of that town, afterwards proceeding, at the age of twenty, to the École Polytechnique at Paris. He was a diligent and successful student, and in 1839 took his degree as a mining engineer. He then travelled for some time through his own country, in Germany, Poland, and the British Islands, and in 1845 was appointed Professor of Geology and Mineralogy at Besançon, where he also practised as a mining engineer. It was during his residence here that he wrote his "Notice sur les Charactères de l'Arkose dans les Vosges," and his "Mémoire sur la Constitution minéralogique et chimique des Roches de Vosges," both of which works appeared in 1847. After a stay of five years at Besançon Delesse returned to Paris, where he was employed as a mining engineer, and was especially engaged in superintending the quarrying operations about the city for nearly eighteen years. In 1855 he prepared the report on building materials in connection with the Exposition Universelle of that year in Paris. In 1864 he was nominated Professor of Agriculture, Drainage, and Irrigatión in the École des Mines. Delesse's earliest researches were directed to pure mineralogy, and he paid great attention to the subjects of pseudomorphs and the association of minerals, and this led him to study the question of the metamorphism of rocks. The outcome of this period of study was his well-known work, "Recherches sur l'Origine des Roches," published in 1865, in which he argued ably and forcibly in favour of the view that crystalline rocks owe many of their characters to the action of superheated water, and are not produced by simple dry fusion. This important work of Delesse has exercised a marked and very beneficial influence on the progress of petrographical science, and its originality and value were at once recognised by the most advanced thinkers of the time. Already in 1858 Delesse had published two of his valuable maps, namely, the "Carte géologique soutteraine de la Ville de Paris" and the "Carte hydrologique de la Ville de Paris," and his subsequent studies came to be especially directed into the channels of inquiry which were associated with the professorship that he had created and so ably filled. In 1868 appeared his work on the Rainfall of France, and other memoirs treating of the agricultural bearings of geology were produced about the same period.

The war of 1870 caused an interruption in the scientific labours of Delesse, and we find him at this period superintending the construction of cartridges in the departments. But in 1878 he was appointed an Inspector-General of Mines, and the south-east of France was assigned to him as his district. During the last twenty years Delesse has issued, in conjunction with MM. Langel and de Lapparent, a series of annual volumes entitled "Revue de Géologie," a work of such value that we regret to hear that it is to be discontinued in the future. Delesse received many honours in recognition of his valuable labours. He was an officer of the Legion of Honour, and filled the post of President of the Geological Society of France. As long ago as 1859 he was elected a Foreign Member of our own Geological Society. He was also for two years President of the French Geological Society, and he occupied the chair during the International Congress of that Society in 1875. In 1879 Delesse was elected a Member of the Academy of Sciences. In Delesse France has lost one of her most distinguished and widely-known scientific men.

PROFESSOR HELMHOLTZ'S FARADAY LECTURE

ON Tuesday evening Prof. Helmholtz gave the Faraday Lecture of the Chemical Society at the Royal Institution. We have so recently (NATURE, vol. xv. p. 389) given a full account of the life and work of the eminent German worker in various departments of science, that it is unnecessary to go over the ground again. A very fair estimate of his position was given in a leading article in the *Times* of Saturday last; and we are glad to notice that the leading journal now is glad to draw attention to men of science whose work is deserving of public notice. The University of Cambridge did itself the honour of conferring upon Prof. Helmholtz the degree of LL.D. on Thursday last, on which occasion the public orator, Mr. Sandys, made the following elegant and appropriate speech:—

"Dignissime domine, domine Procancellarie, et tota Academia:

"Singularum quidem scientiarum terminos protulisse,

plurimis concessum est; uni vero plurimarum fines ex tendisse raro contigit. Atqui hodie virum salutamus, qui rerum naturae regionem plusquam unam feliciter occupavit, qui primum physiologiae penetralia perscrutatus, deinde physicorum studiorum campo amplissimo potitus, ipsam denique mathematicorum arcem fortiter expugnavit, ex alia deinceps in aliam provinciam progressus, velut militum Romanorum ille maximus, 'victrices aquilas alium laturus in orbem.'

"Militarium medicorum ordini adhuc adscriptus, argumentum magnum intra unius libelli fines artiores complexus, ostendit vim illam, quae nonnunquam viva vocatur, in universa rerum natura esse conservatam, partes eius aliam ex alia posse generari, summam esse immutabilem Quid huius ingenio excogitatas commemorem quaestiones illas hydrodynamicas, quid vortices illos qui scientiae mathematicae ad interiora pertinent? Illa vero magna opera, quorum in uno sensus audiendi clarissime explicatur, in altero videndi sensus pulcherrime illustratur, omnes, nisi fallor, aut vidistis ipsi, aut fama certe audivistis. Pulchrum est (uti hunc ipsum confitentem legimus), pulchrum profecto est, e scopulo quodam excelso late tumultuantem oceanum prospicere, fluctusque procul albescentes, modo breviores, modo longiores, oculis discernere · pulchrius autem in physiologiae templo intimo versatum, oculorum ipsorum structuram exquisitam introspicere, et, lucis legibus obscuris ordine lucido evolutis, fluctuantes luminis motus metiri variamque colorum venustatem explicare · omnium fortasse pulcherrimum, in iisdem arcanis morantem, undas illas aeris quas nulla nisi mentis acie contemplari possumus, inter sese audiendo distinguere; sonitus cuiusque, dum tremit vibratque, intervalla numerare; universam denique musices theoriam et mathematicis et physicis et physiologicis probavisse argumentis.

"Ille igitur qui tot provinciarum confinia lustravit, tot scientiarum fines propagavit, a nostra praesertim Academia, cuius alumni totiens ex eodem studiorum campo laureas reportarunt, ea qua par est reverentia hodie excipitur Qui Academiae nostrae nemora, et iuventutis Academicae ludos et certamina iampridem admiratus est, idem fortasse severiora nostra studia quo melius noverit, eo benignius indies aestimabit. Vos certe, qui, talium virorum exemplar procul venerati, etiam nostras inter silvas verum quaeritis, quanquam hodie nemora illa nostra gravis umbra contristat, tamen inter ipsas lacrimas non sine gaudio virum magnum vidistis, quaque soletis benevolentia laudatum audivistis

"Vobis igitur praesento Academiae Berolinensis Professorem illustrem, HERMANNUM LUDOVICUM FERDINANDUM HELMHOLTZ"

The Society of Telegraph Engineers are to give a *conversazione* in honour of the distinguished electrician at University College, Gower Street, on the evening of the 11th inst. The large library and entrance hall will be lit up by electric light, and it is hoped there will be a full display of all the recent novelties in electrical science.

As might have been expected, there was a distinguished audience on Tuesday evening to listen to Prof. Helmholtz at the Royal Institution. Prof. Roscoe, the President of the Chemical Society, in introducing the lecturer, made the following remarks.—

"Ladies and Gentlemen, Fellows of the Chemical Society—The cordial welcome which you have just given to Prof. Helmholtz shows me that he needs no formal introduction at my hands. His name is honoured wherever science is valued, and both his face and his voice are well remembered in this room. It may therefore suffice if I say that eminent as an anatomist, as a physiologist, as a physicist, and as a mathematician, we chemists are now about to claim him also as our own.

"Prof. Helmholtz, in the name of the Chemical Society, and on behalf of its Fellows here assembled, I beg to welcome you amongst us; I have the honour to present you with the Faraday Medal of the Society, and to request that you will favour us with your lecture, to which we shall all listen with pleasure and profit."

The Faraday Lecture[1]

THE majority of Faraday's own researches were connected, directly or indirectly, with questions regarding the nature of electricity, and his most important and most renowned discoveries lay in this field. The facts which he has found are universally known. Nevertheless, the fundamental conceptions by which Faraday has been led to these much-admired discoveries have not been received with much consideration. His principal aim was to express in his new conceptions only facts, with the least possible use of hypothetical substances and forces. This was really a progress in general scientific method, destined to purify science from the last remnants of metaphysics Now that the mathematical interpretation of Faraday's conceptions regarding the nature of electric and magnetic force has been given by Clerk Maxwell, we see how great a degree of exactness and precision was really hidden behind his words, which to his contemporaries appeared so vague or obscure, and it is astonishing in the highest degree to see what a large number of general theories, the methodical deduction of which requires the highest powers of mathematical analysis, he has found by a kind of intuition, with the security of instinct, without the help of a single mathematical formula.

The electrical researches of Faraday, although embracing a great number of apparently minute and disconnected questions, all of which he has treated with the same careful attention and conscientiousness, are really always aiming at two fundamental problems of natural philosophy, the one more regarding the nature of physical forces, or of forces working at a distance; the other, in the same way, regarding chemical forces, or those which act from molecule to molecule, and the relation between these and the first

The great fundamental problem which Faraday called up anew for discussion was the existence of forces working directly at a distance without any intervening medium During the last and the beginning of the present century the model after the likeness of which nearly all physical theories had been formed was the force of gravitation acting between the sun, the planets, and their satellites. It is known how, with much caution and even reluctance, Sir Isaac Newton himself proposed his grand hypothesis, which was destined to become the first great and imposing example, illustrating the power of true scientific method.

But then came Oerstedt's discovery of the motions of magnets under the influence of electric currents. The force acting in these phenomena had a new and very singular character It seemed as if it would drive a single isolated pole of a magnet in a circle around the wire conducting the current, on and on without end, never coming to rest. Faraday saw that a motion of this kind could not be produced by any force of attraction or repulsion, working from point to point. If the current is able to increase the velocity of the magnet, the magnet must react on the current. So he made the experiment, and discovered induced currents; he traced them out through all the various conditions under which they ought to appear. He concluded that somewhere in a part of the space traversed by magnetic force there exists a peculiar state of tension, and that every change of this tension produces electromotive force. This unknown hypothetical state he called provisionally the electrotonic state, and he was occupied for years and years in

[1] Abstract prepared by the author.

finding out what was this electrotonic state. He discovered at first, in 1838, the dielectric polarisation of electric insulators, subject to electric forces. Such bodies show, under the influence of electric forces, phenomena perfectly analogous to those exhibited by soft iron under the influence of the magnetic force. Eleven years later, in 1849, he was able to demonstrate that all ponderable matter is magnetised under the influence of sufficiently intense magnetic force, and at the same time he discovered the phenomena of diamagnetism, which indicated that even space, devoid of all ponderable matter, is magnetisable, and now with quite a wonderful sagacity and intellectual precision Faraday performed in his brain the work of a great mathematician without using a single mathematical formula. He saw with his mind's eye that by these systems of tensions and pressures produced by the dielectric and magnetic polarisation of space which surrounds electrified bodies, magnets or wires conducting electric currents, all the phenomena of electro-static, magnetic, electro-magnetic attraction, repulsion, and induction could be explained, without recurring at all to forces acting directly at a distance. This was the part of his path where so few could follow him; perhaps a Clerk Maxwell, a second man of the same power and independence of intellect, was necessary to reconstruct in the normal methods of science the great building, the plan of which Faraday had conceived in his mind and attempted to make visible to his contemporaries.

Nevertheless the adherents of direct action at a distance have not yet ceased to search for solutions of the electromagnetic problem. The present development of science, however, shows, as I think, a state of things very favourable to the hope that Faraday's fundamental conceptions may in the immediate future receive general assent. His theory, indeed, is the only existing one which is at the same time in perfect harmony with the facts observed, and which at least does not lead into any contradiction against the general axioms of dynamics.

It is not at all necessary to accept any definite opinion about the ultimate nature of the agent which we call electricity.

Faraday himself avoided as much as he could giving any affirmative assertion regarding this problem, although he did not conceal his disinclination to believe in the existence of two opposite electric fluids

For our own discussion of the electro-chemical phenomena, to which we shall turn now, I beg permission to use the language of the old dualistic theory, because we shall have to speak principally on relations of quantity.

I now turn to the second fundamental problem aimed at by Faraday, the connection between electric and chemical force. Already, before Faraday went to work, an elaborate electro-chemical theory had been established by the renowned Swedish chemist Berzelius, which formed the connecting-link of the great work of his life, the systematisation of the chemical knowledge of his time His starting point was the series into which Volta had arranged the metals according to the electric tension which they exhibit after contact with each other A fundamental point which Faraday's experiment contradicted was the supposition that the quantity of electricity collected in each atom was dependent on their mutual electro-chemical differences, which he considered as the cause of their apparently greater chemical affinity. But although the fundamental conceptions of Berzelius' theory have been forsaken, chemists have not ceased to speak of positive and negative constituents of a compound body Nobody can overlook that such a contrast of qualities, as was expressed in Berzelius' theory, really exists, well-developed at the extremities, less evident in the middle terms of the series, playing an important part in all chemical actions, although often subordinated to other influences.

When Faraday began to study the phenomena of decomposition by the galvanic current, which of course were considered by Berzelius as one of the firmest supports of his theory, he put a very simple question, the first question indeed which every chemist speculating about electrolysis ought to have answered. He asked, What is the quantity of electrolytic decomposition if the same quantity of electricity is sent through several electrolytic cells? By this investigation he discovered that most important law, generally known under his name, but called by him the law of definite electrolytic action.

Faraday concluded from his experiments that a definite quantity of electricity cannot pass a voltametric cell containing acidulated water between electrodes of platinum without setting free at the negative electrode a corresponding definite amount of hydrogen, and at the positive electrode the equivalent quantity of oxygen, one atom of oxygen for every pair of atoms of hydrogen If instead of hydrogen any other element capable of substituting hydrogen is separated from the electrolyte, this is done also in a quantity exactly equivalent to the quantity of hydrogen which would have been evolved by the same electric current

Since that time our experimental methods and our knowledge of the laws of electrical phenomena have made enormous progress, and a great many obstacles have now been removed which entangled every one of Faraday's steps and obliged him to fight with the confused ideas and ill-applied theoretical conceptions of some of his contemporaries. We need not hesitate to say that the more experimental methods were refined, the more the exactness and generality of Faraday's law was confirmed.

In the beginning Berzelius and the adherents of Volta's original theory of galvanism, based on the effects of metallic contact, raised many objections against Faraday's law By the combination of Nobili's astatic pairs of magnetic needles with Schweigger's multiplicator, a coil of copper wire with numerous circumvolutions, galvanometers became so delicate that the electro-chemical equivalent of the smaller currents they indicated was imperceptible for all chemical methods. With the newest galvanometers you can very well observe currents which would want to last a century before decomposing one milligram of water, the smallest quantity which is usually weighed on chemical balances. You see that if such a current lasts only some seconds or some minutes, there is not the slightest hope to discover its products of decomposition by chemical analysis And even if it should last a long time the feeble quantities of hydrogen collected at the negative electrode can vanish, because they combine with the traces of atmospheric oxygen absorbed by the liquid. Under such conditions a feeble current may continue as long as you like without producing any visible trace of electrolysis, even not of galvanic polarisation, the appearance of which can be used as an indication of previous electrolysis. Galvanic polarisation, as you know, is an altered state of the metallic plates which have been used as electrodes during the decomposition of an electrolyte. Polarised electrodes, when connected by a galvanometer, give a current which they did not give before being polarised. By this current the plates are discharged again and returned to their original state of equality.

This depolarising current is indeed a most delicate means of discovering previous decomposition. I have really ascertained that under favourable conditions one can observe the polarisation produced during some seconds by a current which decomposes one milligram of water in a century

Products of decomposition cannot appear at the electrodes without motions of the constituent molecules of the electrolyte throughout the whole length of the liquid. This subject has been studied very carefully and for a

great number of liquids, by Prof. Hittorff, of Munster, and Prof. G. Wiedemann, of Leipsic.

Prof. F. Kohlrausch, of Würzburg, has brought to light the very important fact that in diluted solutions of salts, including hydrates of acids and hydrates of caustic alkalis, every atom under the influence of currents of the same density moves on with its own peculiar velocity, independently of other atoms moving at the same time in the same or in opposite directions. The total amount of chemical motion in every section of the fluid is represented by the sum of the equivalents of the cation gone forwards and of the anion gone backwards, in the same way as in the dualistic theory of electricity, and the total amount of electricity flowing through a section of the conductor corresponds to the sum of positive electricity going forwards and negative electricity going backwards.

This established, Faraday's law tells us that through each section of an electrolytic conductor we have always equivalent electrical and chemical motion. The same definite quantity of either positive or negative electricity moves always with each univalent ion, or with every unit of affinity of a multivalent ion, and accompanies it during all its motions through the interior of the electrolytic fluid. This we may call the electric charge of the atom

Now the most startling result, perhaps, of Faraday's law is this · If we accept the hypothesis that the elementary substances are composed of atoms we cannot avoid concluding that electricity also, positive as well as negative, is divided into definite elementary portions, which behave like atoms of electricity. As long as it moves about on the electrolytic liquid each atom remains united with its electric equivalent or equivalents. At the surface of the electrodes decomposition can take place if there is sufficient electromotive power, and then the atoms give off their electric charges and become electrically neutral.

Now arises the question, Are all these relations between electricity and chemical combination limited to that class of bodies which we know as electrolytes? In order to produce a current of sufficient strength to collect enough of the products of decomposition without producing too much heat in the electrolyte, the substance which we try to decompose ought not to have too much resistance against the current. But this resistance may be very great, and the motion of the ions may be very slow, so slow indeed that we should need to allow it to go on for hundreds of years before we should be able to collect even traces of the products of decomposition; nevertheless all the essential attributes of the process of electrolysis could subsist. If you connect an electrified conductor with one of the electrodes of a cell filled with oil of turpentine, the other with the earth, you will find that the electricity of the conductor is discharged unmistakably more rapidly through the oil of turpentine than if you take it away and fill the cell only with air.

Also in this case we may observe polarisation of the electrodes as a symptom of previous electrolysis. Another sign of electrolytic conduction is that liquids brought between two different metals produce an electromotive force. This is never done by metals of equal temperature, or other conductors which, like metals, let electricity pass without being decomposed.

The same effect is also observed even with a great many rigid bodies, although we have very few solid bodies which allow us to observe this electrolytic conduction with the galvanometer, and even these only at temperatures near to their melting-point. It is nearly impossible to shelter the quadrants of a delicate electrometer against being charged by the insulating bodies by which they are supported.

In all the cases which I have quoted one might suspect that traces of humidity absorbed by the substance or adhering to their surface were the electrolytes. I show you therefore this little Daniell's cell, in which the porous septum has been substituted by a thin stratum of glass. Externally all is symmetrical at both poles; there is nothing in contact with the air but a closed surface of glass, through which two wires of platinum penetrate. The whole charges the electrometer exactly like a Daniell's cell of very great resistance, and this it would not do if the septum of glass did not behave like an electrolyte. All these facts show that electrolytic conduction is not at all limited to solutions of acids or salts.

Hitherto we have studied the motions of ponderable matter as well as of electricity, going on in an electrolyte Let us study now the forces which are able to produce these motions. It has always appeared somewhat startling to everybody who knows the mighty power of chemical forces, the enormous quantity of heat and of mechanical work which they are able to produce, and who compares with it the exceedingly small electric attraction which the poles of a battery of two Daniell's cells show. Nevertheless this little apparatus is able to decompose water

The quantity of electricity which can be conveyed by a very small quantity of hydrogen, when measured by its electrostatic forces, is exceedingly great. Faraday saw this, and has endeavoured in various ways to give at least an approximate determination. The most powerful batteries of Leyden jars, discharged through a voltameter, give scarcely any visible traces of gases. At present we can give definite numbers. The result is that the electricity of 1 mgrm. of water, separated and communicated to two balls, 1 kilometre distant, would produce an attraction between them, equal to the weight of 25,000 kilos.

The total force exerted by the attraction of an electrified body upon another charged with opposite electricity is always proportional to the quantity of electricity contained in the attracting as on the attracted body, and therefore even the feeble electric tension of two Daniell's elements acting through an electrolytic cell upon the enormous quantities of electricity with which the constituent ions of water are charged, is mighty enough to separate these elements and to keep them separated.

We now turn to investigate what motions of the ponderable molecules require the action of these forces Let us begin with the case where the conducting liquid is surrounded everywhere by insulating bodies. Then no electricity can enter, none can go out through its surface, but positive electricity can be driven to one side, negative to the other, by the attracting and repelling forces of external electrified bodies. This process going on as well in every metallic conductor is called "electrostatic induction." Liquid conductors behave quite like metals under these conditions Prof Wullner has proved that even our best insulators, exposed to electric forces for a long time, are charged at last quite in the same way as metals would be charged in an instant. There can be no doubt that even electromotive forces going down to less than $\frac{1}{100}$ Daniell produce perfect electrical equilibrium in the interior of an electrolytic liquid.

Another somewhat modified instance of the same effects is afforded by a voltametric cell containing two electrodes of platinum, which are connected with a Daniell's cell, the electromotive force of which is insufficient to decompose the electrolyte. Under this condition the ions carried to the electrodes cannot give off their electric charges. The whole apparatus behaves, as was first accentuated by Sir W. Thomson, like a condenser of enormous capacity.

Observing the polarising and depolarising currents in a cell containing two electrodes of platinum, hermetically sealed and freed of all air, we can observe these phenomena with the most feeble electromotive forces of $\frac{1}{1000}$ Daniell, and I found that down to this limit the capacity of the platinum surfaces proved to be constant. By taking greater surfaces of platinum I suppose it will be possible to reach a limit much lower than that. If any

chemical force existed besides that of the electrical charges which could bind all the pairs of opposite ions together, and required any amount of work to be vanquished, an inferior limit to the electromotive forces ought to exist, which forces are able to attract the atoms to the electrodes and to charge these as condensers No phenomenon indicating such a limit has as yet been discovered, and we must conclude therefore that no other force resists the motions of the ions through the interior of the liquid than the mutual attractions of their electric charges.

On the contrary, as soon as an ion is to be separated from its electrical charge we find that the electrical forces of the battery meet with a powerful resistance, the overpowering of which requires a good deal of work to be done. Usually the ions, losing their electric charges, are separated at the same time from the liquid, some of them are evolved as gases, others are deposited as rigid strata on the surface of the electrodes, like galvanoplastic copper. But the union of two constituents having powerful affinity to form a chemical compound, as you know very well, produces always a great amount of heat, and heat is equivalent to work On the contrary, decomposition of the compound substances requires work, because it restores the energy of the chemical forces, which has been spent by the act of combination.

Metals uniting with oxygen or halogens produce heat in the same way, some of them, like potassium, sodium, zinc, even more heat than an equivalent quantity of hydrogen; less oxidisable metals, like copper, silver, platinum, less. We find therefore that heat is generated when zinc drives copper out of its combination with the compound halogen of sulphuric acid, as is the case in a Daniell's cell.

If a galvanic current passes through any conductor, a metallic wire, or an electrolytic fluid, it evolves heat Mr Prescott Joule was the first who proved experimentally that if no other work is done by the current the total amount of heat evolved in a galvanic circuit during a certain time is exactly equal to that which ought to have been generated by the chemical actions which have been performed during that time. But this heat is not evolved at the surface of the electrodes, where these chemical actions take place, but is evolved in all the parts of the circuit, proportionally to the galvanic resistance of every part From this it is evident that the heat evolved is an immediate effect, not of the chemical action, but of the galvanic current, and that the chemical work of the battery has been spent in producing only the electric action.

If we apply Faraday's law, a definite amount of electricity passing through the circuit corresponds to a definite amount of chemical decomposition going on in every electrolytic cell of the same circuit. According to the theory of electricity the work done by such a definite quantity of electricity which passes, producing a current, is proportionate to the electromotive force acting between both ends of the conductor. You see therefore that the electromotive force of a galvanic circuit must be, and is indeed, proportional to the heat generated by the sum of all the chemical actions going on in all the electrolytic cells during the passage of the same quantity of electricity In cells of the galvanic battery chemical forces are brought into action able to produce work; in cells in which decomposition is occurring work must be done against opposing chemical forces; the rest of the work done appears as heat evolved by the current, as far as it is not used up to produce motions of magnets or other equivalents of work.

Hitherto we have supposed that the ion with its electric charge is separated from the fluid. But the ponderable atoms can give off their electricity to the electrode, and remain in the liquid, being now electrically neutral. This makes almost no difference in the value of the electromotive force. For instance, if chlorine is separated at the anode, it will remain at first absorbed by the liquid; if the solution becomes saturated, or if we make a vacuum over the liquid, the gas will rise in bubbles The electromotive force remains unaltered The same may be observed with all the other gases. You see in this case that the change of electrically negative chlorine into neutral chlorine is the process which requires so great an amount of work, even if the ponderable matter of the atoms remains where it was.

The more the surface of the positive electrode is covered with negative atoms of the anion, and the negative with the positive ones of the cation, the more the attracting force of the electrodes exerted upon the ions of the liquid is diminished by this second stratum of opposite electricity covering them. On the contrary, the force with which the positive electricity of an atom of hydrogen is attracted towards the negatively charged metal increases in proportion as more negative electricity collects before it on the metal, and the more negative electricity collects behind it in the fluid

Such is the mechanism by which electric force is concentrated and increased in its intensity to such a degree that it becomes able to overpower the mightiest chemical affinities we know of If this can be done by a polarised surface, acting like a condenser, charged by a very moderate electromotive force, can the attractions between the enormous electric charges of anions and cations play an unimportant and indifferent part in chemical affinity?

You see, therefore, if we use the language of the dualistic theory and treat positive and negative electricities as two substances, the phenomena are the same as if equivalents of positive and negative electricity were attracted by different atoms, and perhaps also by the different values of affinity belonging to the same atom with different force. Potassium, sodium, zinc, must have strong attraction to a positive charge; oxygen, chlorine, bromine to a negative charge.

Faraday very often recurs to this to express his conviction that the forces termed chemical affinity and electricity are one and the same I have endeavoured to give you a survey of the facts in their mutual connection, avoiding, as far as possible, introducing other hypotheses, except the atomic theory of modern chemistry. I think the facts leave no doubt that the very mightiest among the chemical forces are of electric origin. The atoms cling to their electric charges and the opposite electric charges cling to the atoms But I don't suppose that other molecular forces are excluded, working directly from atom to atom Several of our leading chemists have begun lately to distinguish two classes of compounds, molecular aggregates and typical compounds. The latter are united by atomic affinities, the former not. Electrolytes belong to the latter class.

If we conclude from the facts that every unit of affinity of every atom is charged always with one equivalent either of positive or of negative electricity, they can form compounds, being electrically neutral, only if every unit charged positively unites under the influence of a mighty electric attraction with another unit charged negatively. You see that this ought to produce compounds in which every unit of affinity of every atom is connected with one and only with one other unit of another atom. This is, as you will see immediately, indeed, the modern chemical theory of quantivalence, comprising all the saturated compounds. The fact that even elementary substances, with few exceptions, have molecules composed of two atoms, makes it probable that even in these cases electric neutralisation is produced by the combination of two atoms, each charged with its electric equivalent, not by neutralisation of every single unit of affinity

But I abstain from entering into mere specialities, as, for instance, the question of unsaturated compounds; perhaps I have gone already too far. I would not have dared to do it if I did not feel myself sheltered by the

authority of that great man who was guided by a never-erring instinct of truth. I thought that the best I could do for his memory was to recall to the minds of the men, by the energy and intelligence of whom chemistry has undergone its modern astonishing development, what important treasures of knowledge lie still hidden in the works of that wonderful genius. I am not sufficiently acquainted with chemistry to be confident that I have given the right interpretation, that interpretation which Faraday himself would have given perhaps, if he had known the law of chemical quantivalence, if he had had the experimental means of ascertaining how large the extent, how unexceptional the accuracy of his law really is; and if he had known the precise formulation of the law of energy applied to chemical work, and of the laws which determine the distribution of electric forces in space as well as in ponderable bodies transmitting electric current or forming condensers I shall consider my work of to-day well rewarded if I have succeeded in kindling anew the interest of chemists for the electro-chemical part of their science

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At the conclusion of the lecture Prof. Roscoe made the following remarks —

"The pleasing duty now devolves upon me of proposing a vote of thanks to our distinguished friend for his interesting, suggestive, and most appropriate address.

"Prof Helmholtz has shown us that Faraday's conception of electricity is in exact accordance with the most modern developments of this science. He has told us that although Faraday was unacquainted with the technical details of mathematics, all his conclusions are capable of the most exact mathematical expression, and that our great experimentalist possessed the spirit and thoughts characteristic of a truly mathematical mind But our lecturer has gone further, for upon Faraday's well-known law of electrolysis he has founded a new electro-chemical theory, which reveals to us chemists, conclusions of the utmost importance. He tells us as the results of the application of the modern theory of electricity to Faraday's great experimental law, that the atom of every chemical element is always united with a definite unvarying quantity of electricity. Moreover—and this is most important—that this definite amount of electricity attached to each atom stands in close connection with the combining power of the atom which modern chemistry terms quantivalence. For if the amount of electricity belonging to the monad atom be taken as the unit, then that of the dyad atom is two, of the triad atom three, and so on.

"Hence then, thanks first to Faraday and now to Helmholtz, chemists have now a new and unlooked-for confirmation of one of their most important doctrines from the science of electricity

"These, Ladies and Gentlemen, are indeed sufficient grounds for our claiming Prof Helmholtz as a chemist, and justify me in requesting that he will allow his name to be placed on the list of Honorary Fellows of the Chemical Society.

"I have much pleasure in proposing a hearty vote of thanks to the Faraday Lecturer for the year."

This proposal was seconded by Prof Tyndall.

NOTES

MR. CLARENCE KING has resigned his position as Director of the Geological Survey of the United States. It has long been no secret that he wished to retire from an appointment which confined him chiefly to executive functions, left him with practically no time for independent scientific work, and hampered him in those mining and other financial operations in which he is understood to have large investments. In a letter dated the 12th ult, addressed to the President of the United States, he says that he believes he "can render more important service to science as an investigator than as the head of an executive bureau" All well-wishers to the cause of geology must hope that this belief will be fully justified; that the relief he obtains from official trammels will enable him once more to devote to geological research the energy and experience which have already borne such good fruit. His tenure of office in the Geological Survey has hardly been long enough to enable him fully to develop the plans he had sketched out for the vigorous prosecution of the Survey as a truly national undertaking, alike creditable to the scientific spirit of the Republic and important to the development of its industrial resources. But he will be held in honourable remembrance as the first head of the National Survey, and as having taken a leading share in its initial organisation. It is reported that Mr. J. W. Powell, so long and well known for his work in the Rio Colorado basin, is to be the new director.

A WISH having been expressed by certain members of the Torquay Natural History Society to have a portrait of Mr. William Pengelly, F.R.S , &c., and he having kindly consented to sit for the same, a committee has been formed for carrying the suggestion into effect. The portrait will, at Mr. Pengelly's request, be placed in the museum of the Society, Torquay It was at first proposed to limit the list of subscribers to the members of the Torquay Natural History Society, but some members of the Devonshire Association, and other gentlemen, having expressed a wish to join in the work, it has been decided to make the contribution general Subscriptions will be received by the hon treasurer, Mr Robert Kitson, Torquay Bank.

THE Royal Academy of Sciences of Turin gives notice that from January 1, 1879, the new term for competition for the third Bressa Prize has begun, to which, according to the testator's will, scientific men and inventors of all nations will be admitted. A prize will therefore be given to the scientific author or inventor, whatever be his nationality, who during the years 1879–1882, "according to the judgment of the Royal Academy of Sciences of Turin, shall have made the most important and useful discovery, or published the most valuable work on physical and experimental science, natural history, mathematics, chemistry, physiology and pathology, as well as geology, history, geography and statistics" The term will be closed at the end of December, 1882. The value of the prize amounts to 12,000 Italian lire The prize will in no case be given to any of the national members of the Academy of Turin, resident or non resident.

THE Literary and Philosophical Society of Manchester has recently completed the first century of its existence. Dr. Angus Smith is writing a history of the Society since its foundation, which will be read at an early meeting, and no doubt published in its *Proceedings*.

WE are glad to learn that the appeal on behalf of G. M. Smerdon, who has done such good work as foreman of the Kent Cavern explorations, has resulted in a sum sufficient to purchase him an annuity of 10*l*.

THE results of appointing a totally inexperienced and unknown man to the head of the Registrar-General's department, just before the taking of the census, are already beginning to be felt. Complaints of mismanagement are rife—whole streets in London not served with the census-papers, and in many cases those which were delivered have not yet been collected, and run some risk of being utilised for fire lighting purposes. Certainly the interests of the country would have been best served by appointing Dr. Farr to the post of Registrar-General until at least the census work had been completed. Dr. Farr's long experience would have been of immense service, and these useful statistics would have been collected in something like scientific method.

THERE was a desultory talk on the subject of Technical Education in the House of Commons the other night, on the motion

of Mr. Anderson to appoint a roving Commission to inspect the technical schools of the Continent. The fact is, as Mr. Mundella pointed out, we know quite well what is wanted here, and if the City Guilds would only spend the amount of money they ought to do, there need be no want of technical instruction for all who are prepared to take advantage of it. As it is, such institutions as Owens College, the Mason College, and others are putting a first-rate scientific technical education within the reach of all classes, and what is really wanted is the teaching of elementary science in all our primary schools The House was counted out over the motion.

A MEETING for the purpose of forming a society for the advancement of chemical industry was held on Monday afternoon at the rooms of the Chemical Society, Burlington House, Piccadilly, Prof. Roscoe presiding. The chairman explained that for some time the want of a Society had been felt, the object of which was the advancement of chemical industry in the United Kingdom. Its main purpose would be to bring together at stated intervals all those who possessed chemical, physical, and engineering knowledge, and who used this knowledge in the utilisation of chemical action on a manufacturing scale, and who had the charge of or an interest in chemical industries. It might afterwards prove desirable to found a distinct branch of the engineering profession, who might be designated as chemical engineers. He drew attention to the advantages which would doubtless accrue to the various branches of chemical industry by the establishment of such an organisation. Briefly stated, its objects would be to enable persons interested in chemical industries to meet, to correspond, and to interchange ideas respecting improvements in the various processes, to publish information relating thereto by means of a journal or otherwise, to acquire and dispose of property for such purposes, and to do all other things incidental or conducive to the objects aimed at. Prof. Roscoe concluded by moving that it was desirable to form such a society as that suggested This was seconded by Mr. Perkin and carried. Formal resolutions were then passed with the view of carrying out the object thus agreed upon

WE take the following significant passage from a paper read by Sir George Campbell, K C S.I., M.P., late Lieutenant-Governor of Bengal, to the Society of Arts on March 25 last.—"Most of us who go to India know very little about agriculture of any kind, and of agriculture under the conditions of Indian soil and climate we know nothing whatever. The consequence has been that when we have attempted to show the natives how to improve their agriculture we have generally egregiously failed, and to use a native expression, our faces have been blackened In this respect I am afraid we are not improving. The old-fashioned civil servant, if not so literary as the new class, and perhaps not much more agricultural, settled down more in the country and learned more of native agricultural habits and ways Present administrators, I am afraid, know very little of any kind of agriculture, and it is much the same with the native public servant; formerly they knew nothing of English literature, but they knew a great deal of the country; now they are very highly educated, but do not know much more of agriculture than their European superiors."

THE post of Curator of the Herbarium of the Royal Botanic Gardens, Calcutta, has been filled up by the India Office by the appointment, on the nomination of the Director of the Royal Gardens, Kew, of Mr. L. J. K. Brace, of New Providence, Bahamas. Mr. Brace was educated at Christ's Hospital, and held a subordinate post in the colony. Having turned his attention to botany, he was employed by the late Governor, Mr. W. Robinson, to make a collection for Kew of the indigenous vegetation.

OF late years the cultivation of Liberian coffee (*Coffea Liberica*) has been energetically pushed in English coffee-growing colonies and possessions. This has been due to two causes.—First, the cultivation of Arabian coffee (*Coffea Arabica*) has been severely crippled in the New World by the "white fly" (*Cemiostoma coffeellum*), and in the Old by the "leaf disease" (*Hemileia vastatrix*); secondly, Liberian coffee being a more tropical plant, grows well at a zone of altitude below that which Arabian coffee requires. The produce of the plantations of the new species is now coming into commerce. At present it does not find much favour apparently in England, but in America it is better appreciated Recent sales at New York of Ceylon-grown Liberian coffee have realised 93*s*. per cwt., or 12*s* above the current quotation for middling plantation coffee (Arabian) in the London market. This is a result of great importance for the West Indian Islands. Liberian coffee has been found in Dominica to possess a comparative immunity from the attacks of the white fly, the ravages of which had all but completely extinguished the coffee-cultivation of the island Not merely therefore can West Indian coffee cultivation be revived with reasonable prospect of success, but there is the additional encouragement of a ready market easy of access in the United States

THE death is announced, at the age of seventy-five, of Sir Philip de Malpas Grey Egerton. Sir Philip was an occasional contributor to our pages

A STRONG shock of earthquake occurred on Sunday afternoon at Chio, which has caused terrible destruction. Many houses in the principal town and thirty villages in the island are said to have been destroyed, and 4000 persons killed. Fresh shocks of earthquake occurred on Monday, and the inhabitants were taking refuge on board the steamers in the harbour The country around and the town Tsesme, on the mainland, suffered considerably, and shocks were also felt on Monday at Zante, Syra, Smyrna, Carosto, Eubœa, and Tinos The island of Chio, Scio, or Skio, for the name is thus variously spelt, is situated in the Ægean Sea, separated from the coast of Anatolia by a channel not more than seven miles wide where narrowest, and about fifty-three miles west of Smyrna.

SOME of our readers may be glad to learn that the French Association has resolved to curtail the number of scientific meetings in order to extend the time left for excursions and festivals The programme includes two receptions by the Mayor of Algiers, one by the Governor-General, and a large Arabian *fête* called *Bita*, dancing and singing by native women, &c. Possibly the reported massacre of the Flatters Expedition may put a stop to these ultra-scientific festivities

WE notice that the names of Drs. Gladstone and Tribe are down for a paper in the Physical and Chemical Section of the meeting of the French Association at Algiers, as also that of Mr. Rodwell.

AT the ordinary meeting of the Sanitary Institute, to be held at 9, Conduit Street, on Wednesday, April 13, at 8 p m., the Chairman of Council, Dr. Richardson, F.R.S, will give a short address entitled, "Some Brief Suggestions on the Best Mode of dealing with Small Pox and other Infectious Diseases in the Metropolis and other large Towns," to be followed by a discussion

MR. R. J. FRISWELL writes:—As the following novel "facts" have their origin in *Truth* there can, I presume, be no gainsaying of them. As they are entirely new and are published in a journal not so well known as a scientific paper as it ought to be, will you be good enough to give them a wider currency for the information of chemists Their value needs no comment.—"The bomb with which the Emperor was killed appears to have been filled with nitro-glycerine, and it is unfortunate that this compound, like gun-cotton, is so easy to make. A certain amount of glycerine is taken, and to this

sulphuric and nitric acid are added. Glycerine has an affinity for water. A molecule of water is abstracted, and a molecule of nitrous acid takes its place. Nitro-glycerine may be put into the fire or it may be struck without any dangerous consequence. If however it be set on fire by a fulminant, there is an explosion. If, as stated, the Russian bombs were made of glass, there must have been small projections made in the glass shell when manufactured, filled with fulminating powder. The explosive character arises from this: Nitrogen is composed of molecules in pairs of atoms. Nitric acid contains only one atom in its molecules. Upon this atom being set free from its unstable combination in the glycerine, the two atoms of nitrogen rush together, producing a vast amount of energy of combination in the shape of heat. The gaseous products are thus heated, and an explosion takes place immediately."

A SCHOOL of Gardening and Practical Floriculture has been established at the Crystal Palace, under the superintendence of Mr. Edward Milner.

M. DAUDIGNY, electrical engineer in Paris, has sent to the Municipal Council a petition asking for authority to establish on the top of the Colonne de Juillet a large electric lamp fed by a magneto-electric machine of fifty horse-power. This enormous light is to be diffused by a large reflector of special construction.

A MOST successful experiment in theatre illumination was tried on March 30 and 31, at the Athenæum of the rue des Martyrs, Paris, with the Werdermann incandescent light. The peculiarity of it is that it can be graduated at will for scenic effects, either by introducing resistance coils or varying the velocity of the Gramme machine. These experiments were witnessed by several influential members of the Municipal Council, who on the following morning proposed an inquiry into the propriety of obliging all the theatrical managers to light their halls with electricity.

MR. F. W. PUTNAM sends us a paper on Pueblo Pottery, which he contributed to the February number of the *American Art Review*. There are some well-executed coloured illustrations of specimens of the pottery which show some little taste in colour and ornamentation

WE have had several replies to our inquiry concerning the late Dr. Thomas Dick's astronomical instruments. They seem to have been disposed of after his death, and only one small instrument can be definitely traced. None of the instruments seem to have been of much scientific value

MR. JOHNSTON-LAVIS writes, under date March 29.—"Vesuvius is to-night again active, lava running down the north-western slope of the cone. Only the reflection is visible from Naples On Sunday morning a slight shock, or more correctly subterranean thunder, was felt at Casamicciola, although those in the ruins at the moment only became aware of it by the palor of others present, whose whole attention is arrested by the faintest move or noise."

A SCIENCE Students' Association has been formed in Liverpool, which includes all departments of science in its programme, the president is Mr. A. Norman Tate.

THE system of compressed-air clocks, of the use and construction of which in Paris we gave an account some time ago, is likely to have a trial in London. A Bill has been introduced into Parliament for this purpose. The number of stations proposed for the metropolis is ten.

IN the notice of the meeting of the Mathematical Society in NATURE, vol. xxiii. p. 379, Mr. Wooster Woodruff Beman's name was misspelt Benson.

LIEUT.-COL. H. COLLETT, of Meean Meer, North-West Punjab, has sent us a money-order for 3*l.* towards the John Duncan Fund. We also acknowledge receipt of 1*l.* from M. G. S.

THE additions to the Zoological Society's Gardens during the past week include a Two-Spotted Paradoxure (*Nandinia binotata*) from West Africa, presented by Mr. A. Wentworth Forbes; a Golden Sparrow (*Auripasser euchlorus*) from Abyssinia, presented by Mr. J. Abrahams; a Chukar Partridge (*Caccabis chukar*), a Grey Francolin (*Francolinus ponticerianus*) from India, presented by M. J. M Cornely, C.M.Z.S.; two Indian Antelopes (*Antelope cervicapra* ♂ ♂) from India, deposited; two Æthiopian Wart Hogs (*Phacochœrus æthiopicus* ♂ ♀) from South-East Africa, a Dusky Parrot (*Pionus violaceus*) from Guiana, three Ceylonese Hanging Parrakeets (*Loriculus asiaticus* ♂ ♂ ♀) from Ceylon, a Yellow Troupial (*Xanthosoma flavus*) from Buenos Ayres, purchased; a Fork tailed Jungle Fowl (*Gallus furcatus* ♂) from Java, on approval; two Four-horned Antelopes (*Tetraceros quadricornis* ♂ ♀), a Burrhel Wild Sheep (*Ovis burrhel* ♂) from India, a Javan Adjutant (*Leptoptilus javanicus*) from Java, a Rock-hopper Penguin (*Eudyptes chrysocome*) from the Falkland Islands, received in exchange.

OUR ASTRONOMICAL COLUMN

THE VARIABLE STARS U CEPHEI AND U GEMINORUM.—We learn from Mr Knott that Ceraski's short-period variable in Cepheus was at a minimum on March 29 at about 12h 45m. G M T., clouds prevented observations till 11h. 35m, when it had barely fallen to minimum, for two hours, 11h. 45m.—13h. 45m, the star's light was sensibly constant—about 9·4m. On April 3 Mr. Knott again obtained a pretty complete observation, the time of minimum, taking the middle of the phase, was 12h. 24m G.M T., for nearly 2h. 30m, or from 11h. 10m. to 13h. 36m., the star remained about 9 4m. Guided by these and previous observations the following approximate times of minima are inferred, and it is to be hoped that the series may be well observed.—

		h m.			h m.			h m.
April	8	12 4	April	23	11 2	May	8	9 59
	13	11 43		28	10 41		13	9 39
	18	11 22	May	3	10 20		18	9 18

This variable has been hitherto called T Cephei in this column, but Mr. Knott draws attention to the circumstance that Ceraski (*Astron Nach*, No. 2343) applied that designation last October to another variable discovered by him, the position of which by meridian observations at Moscow was found to be in R.A. 21h. 7m. 57·05s., Decl + 68° 0′ 8″·4 for 1880·0, and we accordingly follow his suggestion that the short-period variable will be more properly termed U Cephei

U Geminorum was observed by Mr. Knott at about the maximum, or about 9 3m., on April 2 and 3. Maxima of this very irregular variable star are by no means easy to catch. It precedes the principal component of Σ 1158 by 1m. 26·5s, and is north of it 7′ 31″ Prof. Winnecke gave a series of comparison stars in *Astron Nach.*, No. 1120 Argelander's position for 1855 is R.A 7h. 46m. 29 88s., Decl + 22° 22′ 41″·5.

While writing upon variable stars we may mention that B.A C. 4767 is probably to be included among them It was estimated 4m. by D'Agelet on May 15, 1783, it is called 6m. by Lacaille, Lalande, and Piazzi, and was so estimated in Argelander's Zone, No 301; but although rated 5·7 in the *Uranometria Argentina* it is not found in Heis's Atlas nor in the Uranometria of Argelander. Its place for the present year is in R.A. 14h. 18m. 1s, with south declination, 24° 15′·6.

THE COMET OF 1812.—Several years since, Mr. W. E Plummer of the University Observatory, Oxford, after a new reduction of the observations made at Paris and Viviers, which we possess in their original form, found the period of revolution about 1½ years less than that given by Encke, so that it is quite possible that the comet may arrive again at perihelion within the present year. We have already mentioned that M. Schulhof of Paris is engaged upon a strict investigation of the elements of this comet, and has the intention of preparing extended ephemerides, in the same manner that he has done for several of the minor planets which had not been observed at several oppositions, but the sweeping lines for every fourth day throughout the year are given in Herr Mahn's ephemeris computed on the suggestion of Prof. Winnecke, which will be found in the *Vierteljahrsschrift der Astronomischen Gesellschaft*, 12 Jahrgang.

BIOLOGICAL NOTES

THE SHINING SLAVE-MAKER (POLYERGUS LUCIDUS).—The Rev H. M'Cook is as fortunate as he is energetic in his studies of the American ants. At the December 1880, meeting of the Academy of Natural Sciences of Philadelphia he read a paper on the discovery at the foot of the Allegheny Mountains, near Altoona, of a nest of *Polyergus lucidus*, the American representative of the Legionary Ant of Huber (*P. rufescens*), an ant associated with that author's discovery of ant nests, in which certain ants have associated with them, in a sort of slavery, ants of another species. The nest had four gates separated a few inches from each other, the chambers were placed one above the other, united by tubular galleries. In an inner ovoid chamber numbers of the ants, male and female, appeared; mingled with these in large numbers were workers in three forms—major, minor, and dwarf of *Formica Schauffusii*. A portion of the excavated nest was broken into, and on the next day but one was visited. None of the shining ants were at work, but the "slaves" were very busy cleaning out the galleries; a portion of the slaves were engaged in an extensive migration; a few were carrying their fellows, but for the most part the deportation was confined to the males and females of the shining ants. It was wonderful to see the large virgin-queens carried up the perpendicular face of the cutting for eighteen or twenty inches, and then for the distance of six feet over the ground and through the grass, and this in a few seconds over a minute. The shining ants are able to take a most wonderful grip. One of them had fallen under the displeasure of another, who held her firmly grasped by the middle thorax. Anxious to preserve the colony from unnecessary loss, Mr M'Cook lifted the two out on the point of a quill toothpick, laid them on his hand, and thrust the fine point of the quill between the jaws of the agressor, and so teased her that she released her fellow. The rescued ant instantly clasped the palm of his hand, threw her abdomen under her, and then, with back curved like that of an angry cat, sawed and tugged away at the skin until an abrasion was made. The other ant still clung fast by her mandibles only to the toothpick's point, her body stretched out into space, her limbs stretched outwards, except one hind leg, which was a little bent upward, and thus without any perceptible support except that which her jaws gave her upon the quill-point, she hung outstretched for several minutes. About a month after its discovery the nest was again visited; it was abundantly peopled; the winged forms of the shining ant were however gone. Having succeeded in colonising these ants Mr. M'Cook was able to confirm in many particulars the statements of Huber, Forel, and others, but he never happened to see the slaves feeding their masters. He noticed that they seemed to like to move towards both warmth and light, but he does not seem to have settled the question whether they would not prefer the warmth without the light. They would appear to be very clean in their ways and persons. Various experiments seemed to establish the fact that these slave-makers always keep a guard ready at once for any attack.

ON THE RED COLOUR OF SALT COD.—During the hot and damp weather of summer in the United States the dried codfish sometimes exhibit a peculiar redness of colour. These red fish, as is well known, putrefy comparatively quickly, and this fact, taken in connection with the disagreeable, and in such fish unusual, colour, renders them unfit for market, so that in seasons when the redness prevails dealers in codfish suffer often very considerable losses. Prof. Farlow, M.D., was requested by the United States Fish Commission to investigate this subject, and his report appears in the Fish Report for 1880. In September, 1878, he went to Gloucester to examine the fish stores. The weather was at that time hot and damp, and the codfish then being prepared for the market were largely affected by the redness. This redness disappears with the return of cool weather. In most cases it does not appear until the fish have been landed from the vessels, though in a few cases the colour has appeared in the stock while still on board. A microscopical examination showed that the redness was owing to a very minute plant, *Clathrocystis roseo-persicina*, a species known to be closely related to *C. æruginosa*, so common in fresh-water ponds, and which has lately come into public notice in the States in consequence of the so-called *pig pen* odour which it exhales when decaying. This red species is known both in America and Europe, and has been recently investigated by Cohn and others. It may sometimes be found tinging the surface of damp ground with a purplish tinge, and the anatomist is not unfamiliar with it as growing in his macerating tubs. It would appear not to flourish or increase very rapidly at a temperature below 65° Fahr. How it got to attack the dried fish was the next question. It was found that the plants could come from many sources, for it was found present in quantities in the wood-work of the wharves and packing-stores, but above all Prof Farlow detected it in the salt with which the fish were cured. The salt from Cadiz had even a slight rose tinge. It will be a matter of interest, which perhaps some of our readers may help to solve, as to whether this plant is known in European fish-stations. In the great Norwegian cod-fisheries the temperature may not be high enough to favour its growth. As remedies Prof. Farlow suggests care in the selection of salt, and the constant cleaning of all wood-work or vessels that may come in contact with the fish. In addition to the red alga small quantities of cells destitute of colouring-matter and arranged in fours were not unfrequently found in the infected cod-fish. These suggested the genus Sarcina, but were not *S. ventriculi*. They rather, except in the absence of colouring-matter, resembled *Glœocapsa crepidinum*, Thuret, which species is common enough on the wood-work of the Gloucester wharves. While there is this resemblance Prof. Farlow prefers for the moment, and pending further investigation, to call it a Sarcina, and to describe it as a new species (*S. ? morrhuæ*)

MARINE ISOPODS OF NEW ENGLAND.—One of the most remarkable papers forming the extensive series of appendices to the Report of the United States Commissioners of Fish and Fisheries for 1878 is perhaps that by Oscar Harger on the marine Isopods of New England and adjacent waters. The limits chosen commence at Nova Scotia to the north and extend southwards to New Jersey. Forty-six species are recorded, and figures of these with the requisite details of anatomy are given on thirteen plates; several new species and one new genus (Syscenus) are described. It will be noted that the number of species is very considerably less than that known to frequent the British coasts, and of the former only eight are identical with British forms. This difference is very marked in the genus Sphæroma, of which genus there is but one species native to New England, while Bate and Westwood describe a dozen species belonging to this family as natives of Britain. *Limnoria lignorum*, one of the most destructive of the group, is apparently as common on the American coasts as on our own shores. It does not usually occur much below high-water mark, though Prof Verrill has found it at a depth of ten fathoms in Casco Bay, and it was dredged by the U.S. Fish Commission at a depth of 7½ fathoms in Cape Cod Bay, Massachusetts. Of the family of the Cymothoidæ, of which we believe as yet no species has been found around the British Islands, three species belonging to three different genera are in Mr Harger's list.—To this memoir there is appended a very complete list of authorities and an alphabetical index.

STATISTICS OF DISEASE IN ITALY.—In a recent paper to the Lombard Institute, Prof Sangalli gives statistics of the diseases which terminated fatally in the Civic Hospital of Pavia during the period 1855 to 1881. The material was 6644 bodies which came up for autopsy, and the causes of death were, in decreasing order, genuine inflammation, 4504 deaths, tuberculosis, 808; pyæmia, 337, cancer, 366; hepatic cirrhosis, 252, extravasation of blood in the brain, 254, chronic ulcer (gastric and duodenal), 72, &c (there being 2140 deaths apart from those by true inflammation). The 4504 deaths from inflammation presented 7962 separate inflammations. The deaths from tuberculosis are seen to be about 12 per cent. The ages most exposed to that disease lie between 20 and 30; next come those between 10 and 20, and between 30 and 40, about equal. There were twelve cases between 70 and 80, and one in an old man of 84. It does not appear that one sex suffers more than the other. Cancer occurs most between 50 and 60, and most largely in liver, lymphatic glands, and stomach. The patients were largely of the peasant class, and the author cannot support Niemeyer's view, that people living in marshy districts, liable to malaria, have a certain immunity from tuberculosis. Nor do the figures confirm the asserted tendency of ulcer in the stomach to favour the development of tuberculosis. Pyæmia appeared mostly in the lungs (149 cases out of 470), pleura, 99; liver, 73, &c. In some years there was a remarkable diminution of this disorder.

THE EYE AND INTENSITY OF COLOUR.—With an apparatus consisting of two Nicols with a gypsum plate between, and a spectroscope with a third Nicol attached to the eye-piece, Herr Dobrowolsky has examined the sensibility of the eye to spectral

colours with different intensities of light (Pflüger's *Archiv*, v. 24, p. 189). From a large number of measurements it was found that, on an average, the red colour sensation first occurred with a light-quantity equal to [illegible], while for blue the lowest amount of light was [illegible]. Thus blue gives a sensation with an amount of light sixteen times less than that required for red. With rise in the degree of brightness, the increase of sensibility to red proceeds pretty regularly, but for blue the increase becomes gradually greater (with the weakest degrees of brightness this increase was = 0·22, with the strongest 0·82, with the mean 0·36). Comparing the two sensibilities together, from the maximum of light strength to the minimum, the sensibility to blue is always found to exceed that to red (maximum thirteen and a half times, minimum sixteen times, mean four times).

ISOETES LACUSTRIS.—In an interesting paper read before the Academy of Sciences of Paris (January 10, 1881), M. E. Mer calls attention to the peculiar conditions under which different forms of this fresh-water plant seem to originate in the Lake of Longemer. The basin of this lake was once occupied by a glacier, and now presents several different sorts of bottom. The soil to a depth of two to three metres is composed in part of a gravel formed of rock *débris* united by an iron cement, in part of ancient moraines, or where near the surface these will be mixed with the remains of plants and form a pretty tenacious mud. In all these situations Isoetes is to be found, but the plants differ most remarkably both as to their form, their structure, and their mode of reproduction as they are found in the different habitats. Taking the leaf-development as a guide, four varieties are easily discerned:—(1) *humilis*, growing sparsely in the gravel and sterile shallows, the leaves are not only few in number, but always of diminutive dimensions, sporange generally wanting or represented by a small cellular mass which rarely ever forms a propagule, and then these with puny leaves; (2) *stricta*, found on the borders of the lake or in the old alluvial, therefore in less sterile quarters than the preceding, leaves more numerous, stout, but still of small size; (3) *intermedia*, growing on ground formed of a mixture of mud and clay, either on the borders of the lake or at a depth of from one to two metres, leaves quite intermediate in character between the previous variety and the next; (4) *elatior*, growing on the clayey depths, with long leaves. The first form is always found isolated, and as to its asexual reproduction there is nothing more to be said, but the other three, according as they are subject to more or less heat, present each three varieties characterised by the mode of reproduction. 1. *Sporifera*, isolated individuals, mostly furnished with well-developed sporangia, stem large, roots numerous, leaves large. 2. *Gemmifera*, few fertile sporangia, but most of the leaves are furnished with propagula, and these well furnished with leaves, generally dextral, stem fairly developed. 3. *Sterilis*, individuals growing in compact masses, stems and roots slender, leaves not numerous, long and narrow, fertile sporangia very rare, and more often undeveloped masses of cells or abortive propagula. It would seem as if these facts had a practical interest to the collector, who may find in them a guide as to where to look for fertile specimens.

GEOGRAPHICAL NOTES

ON Friday, April 1, the French Geographical Society held a meeting in the large hall of the Sorbonne for the reception of Dr. Lenz on his return from Timbuctoo. M. Milne-Edwards was in the chair. Dr. Lenz, as our readers know, has been very successful, although his conclusions are adverse to the construction of a railway from the Niger to Algeria throughout the Sahara. On the following morning the Society received a telegram stating that Col. Flatters had been murdered by Touaregs at some distance from the Lebhkha Amagdor. In the evening the sad news was confirmed by an official message, stating that four starving Arabs from the mission had arrived at Ouargla, and that the Khobfa had left with four hundred mehari and camel horsemen to rescue the survivors, who were besieged south of Messaguer in the Touat region proper. Happily the news of the disaster to Col. Flatters' expedition has not yet been further confirmed, and authorities in Paris are inclined to believe that it has been much exaggerated, and that the story of the four natives has many elements of suspicion about it.

DR. LENZ, in his lecture at Paris, gave some interesting details on the present condition of Timbuctoo. Its houses are built of brick, and the population is now only 20,000. It has greatly decayed, and the inhabited part of the town is surrounded by great spaces covered with ruins. There are numerous schools and rich libraries. Dr. Lenz had a cordial reception, and every night during his twenty days' stay he was present at religious conferences which the learned men of the city held with his interpreter; the commentaries on the Koran formed the only subject of conversation. Timbuctoo is united with the Niger, six miles off, by a series of lakes, formerly canals. Dr. Lenz has also made some interesting observations on the Sahara, tending to confirm the conclusions of Rholfs and other recent scientific travellers as to the variety which is to be met with in the great desert. It is really a plateau about 300 metres in altitude, no part of it being below the level of the sea. Granite hills, sandy plains, shallow lakes, fertile oases, alternate over nearly the whole surface, while beasts of prey are rarely to be met with. Dr. Lenz will contribute a full account of his journey to the Berlin Africa Society, in whose journal many of his letters have already appeared.

IT is with sincere regret that we record the death of Lieut. Karl Weyprecht, at the age of forty-three, on March 29, of consumption. Lieut. Weyprecht will be known to our readers as the discoverer, with Lieut. Payr of Franz-Josef Land, in the Austro-Hungarian Expedition of 1872–4. His observations on the aurora borealis were of especial value, and he has published several papers on the subject. He was also the originator of the scheme for establishing a series of international observations around the Pole, which is likely to be realised next year.

THE Rev. G. Brown, the well-known representative of the church militant in the South Pacific, contributes to the new number of the Geographical Society's *Proceedings* a paper descriptive of a recent journey which he has made along the coasts of New Ireland and the adjacent islands, the latter including Sandwich Island, Portland Islands, and New Hanover. Dr. Benjamin Bradshaw, who has spent some years in collecting natural history specimens in the Upper Zambesi region, also contributes a brief paper on the Chobe River, together with a sketch-map of a portion of its course, adding materially to our knowledge of the geography of this region. Mr. Crocker's paper on Saráwak and Northern Borneo, lately read before the Society, is also given, and is illustrated with a good map. The geographical notes are full of interesting matter, one giving an account, by Mr. Sibiriakoff himself, of the voyage of the *Oscar Dickson* to the Yenisei Gulf in 1880. Another furnishes conclusive proof of the usefulness of the course of scientific instruction provided by the Council for intending travellers in foreign countries. From the last note we learn that Mr. C. R. Markham, the indefatigable secretary, is preparing for the forthcoming volume of the *Journal* a sketch of the Society's work in the past fifty years.

IN the current number of *Les Missions Catholiques*, Père Richard, a missionary in Algeria, commences an account of his journey, in company with Père Kermabon, among the Tuareg-Azguer tribes of the Sahara. The object of their journey was to study this almost unknown region, and to cultivate friendly relations with the chiefs and people generally with a view to the formation of a missionary station. The more interest attaches to Père Richard's narrative, as it deals with the very region which Col. Flatters has been now exploring with the object of settling the best practicable route for the projected Trans-Sahara railway. An entirely new map of this part of Africa, based on Père Richard's notes, accompanies the number.

A LATELY-ISSUED batch of *Reports* from H.M. Consuls (Part VI. of last year) contains useful geographical information respecting portions of South America, that relating to Chili and Peru being specially interesting at the present moment.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—On the 31st inst. the honorary degree of LL.D. was conferred on Prof. Helmholtz of Berlin at a special congregation.

Prof. Humphrey will take his usual May classes for the second M.B. and Natural Sciences Tripos next term, and the demonstrator will give demonstrations of the organs.

Prof. Babington will lecture on botany four times a week next term, beginning April 26. Mr. Hillhouse will give lectures on

morphology and systematic botany, with practical work in the Botanical Gardens.

The Demonstrator of Comparative Anatomy will take an advanced class for instruction in the mammalia during the Easter term.

Prof. Stuart next term opens his new workshops and drawing office; in the latter instruction will be given in mechanical drawing and in machine designing, and also in graphical statics and its application to the theory of structures.

Mr. Garnett will commence an elementary course of lectures on electricity and magnetism on May 2 in the chemical laboratory of St. John's College.

The Senate has approved of Lord Rayleigh's appointment of two joint demonstrators of physics instead of one, and of the payment of a stipend of 100*l.* to each.

Mr. Balfour will lecture on the embryology of aves and mammalia next term, and have a practical class in that subject.

THE Court of Assistants of the Haberdashers' Company have have given to each of the schools under their management a cabinet of minerals, purchased from the executors of the late Prof. Tennant. The schools of the Company are at Monmouth, Newport, Hatcham, and Hoxton.

SCIENTIFIC SERIALS

Annalen der Physik und Chemie, No. 3.—Constants of elasticity of fluor-spar, by H. Klang.—On the source of beats and beat-tones in harmonic intervals, by R. Koenig.—Description of a beat-tone apparatus for lecture experiments, by the same.—Contribution to the theory of resonance, by F. Kolacek.—Some applications of the law of dispersion to transparent, semi-transparent, and opaque media, by E. Ketteler.—Researches on the spectra of gaseous bodies, by F. Lippich.—On the electromotive force of galvanic combinations formed of zinc, sulphuric acid and platinum, or copper, silver, gold, or carbon, by C. Fromme.—On a new form of the Topler mercury pump, and some experiments made with it, by E. Bessel Hagen.—Researches on the height of the atmosphere and the constitution of gaseous heavenly bodies (continued), by A. Ritter.—On absorption of solar radiation by the carbonic acid of our atmosphere, by E. Lecher.—On the idea of galvanic polarisation, by W. Beetz.—On an artificially-formed body which takes polar directions and shows polar attractions, by W. Holtz.

Zeitschrift fur wissenschaftliche Zoologie, vol. xxxv part 2, February, 1881.—Dr. H. Adler, on the alternation of generations in the oak-gall insects, pp. 150-246, a very exhaustive treatise, with two admirably-coloured plates of the galls and one of the ovipositors, &c., of the gall insects.—Hans Virchow, on the vessels in the eye and the appendages of the eyes in frogs, with two plates. Elias Metschnikoff, researches on the Orthonectidæ, with a plate.—Jos. Th. Cattie, contribution to a knowledge of the chorda supra-spinalis of the lepidoptera and of the central, peripheral, and sympathetic nerve systems in caterpillars, with a plate.—Dr. H. Bolau, on the pairing and propagation of a species of the genus Scyllium.—N. Kleinenberg, on the origin of the ova in Eudendrium (with a woodcut).

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 24.—"Observations on the Locomotive System of Echinodermata." (The Croonian Lecture.) By G. J. Romanes, M.A., F.R.S., and Prof. J. C. Ewart, M.D.

The principal results had reference to the tube-systems and nervous systems of the echinoderms. It was shown by injection that the ambulacral system and the so-called blood-vascular system are each closed systems, save at their common origin in the madreporic plate. Both systems communicate through this plate with the internal medium, but the one much more freely than the other, the ambulacral system being the least patent, so that it is only when a pressure of two feet is maintained for a number of hours that the injected fluid slowly permeates the stone-canal, or sand-tube, to ooze through the madreporic plate. Regarding the nervous system, it was found in Echinus that lateral branches arise from the five radial trunks to escape with the pedicels through the apertures of the pore plates. Each of these branches then courses down the pedicel, with which it escapes to the terminal sucker. From these lateral branches there also arises an intimate nerve-plexus, which covers the whole external surface of the shell, lying almost immediately beneath the surface epithelium, and extending from the shell to all the spines and pedicellariæ. In stained specimens the nerve-fibres and cells were traced to the capsular muscles at the bases of the spines, and delicate fibres were detected running up the spines and pedicellariæ, immediately below their epithelium. In the case of the pedicellariæ it appeared from several preparations that delicate fibres extended as far as the sensitive epithelial pod situated on the inner surface of each trident mandible, a short distance from the apex.

Such being the principal morphological results, the paper went on to detail a number of physiological experiments. First it was pointed out that the natural movements of echinodermata exhibit a high degree of co-ordination. Thus, for instance, all the echinoderms are able when inverted on a flat floor to right themselves. The common starfish does this by twisting the ends of two or more of its rays round, so as to bring the terminal suckers into action upon the floor of the tank, and then by a successive and similar action of the suckers further back in the series the whole ray is progressively twisted round, so that its ambulacral surface is applied flat against the floor. The rays which perform this action twist their spirals in the same direction, and by this concerted action drag the disk and the remaining rays over themselves as a fulcrum. Other species of starfish which have not their ambulacral suckers sufficiently developed to act in this way execute their righting movements by doubling under two or three of their adjacent rays, and turning a somersault over them, as in the previous case. Echinus rights itself when placed on its aboral pole, by the successive action of two or three adjacent rows of suckers—so gradually rising from aboral pole to equator, and then as gradually falling from equator to oral pole. Spatangus executes a similar manœuvre entirely by the successive pushing and propping action of its longer spines.

Experiments in stimulation showed that all the echinoderms observed sought to escape from injury in a direct line from the source of irritation. If two points of the surface are stimulated the direction of escape is the diagonal between them. When several points all round the animal are simultaneously stimulated the direction of advance becomes uncertain, with a marked tendency to rotation upon the vertical axis. If a short interval of time be allowed to elapse between the application of two successive stimuli the direction of advance will be in a straight line from the stimulus applied latest. If a circular band of injury be quickly made all the way round the equator of echinus, the animal crawls away from the broadest part of the band, *i.e.* from the *greatest amount* of injury.

The external nerve plexus supplies innervation to three sets of organs—the pedicels, the spines, and the pedicellariæ; for when any part of the external surface of echinus is touched, all the pedicels, spines, and pedicellariæ within reach of the point that is touched immediately approximate and close in upon the point, so holding fast to whatever body may be used as the instrument of stimulation. In executing this combined movement the pedicellariæ are the most active, the spines somewhat slower, and the pedicels very much slower. If the shape of the stimulating body admits of it, the forceps of the pedicellariæ seize the body and hold it till the spines and pedicels come up to assist.

And here we have proof of the function of the pedicellariæ. In climbing perpendicular or inclined surfaces of rock covered with waving seaweeds it must be no small advantage to an echinus to be provided on all sides with a multitude of forceps adapted, as described, to the instantaneous grasping and arresting of a passing frond; for in this way not only is an immediate hold obtained, but a moving piece of seaweed is held steady till the pedicels have time to establish a further and more permanent hold upon it with their sucking disks. That this is the chief function of the pedicellariæ is indicated by the facts that (1) if a piece of seaweed is drawn over the surface of an echinus this function may clearly be seen to be performed, (2) that the wonderfully tenacious grasp of the forceps is timed as to its duration with an apparent reference to the requirements of the pedicels, for after lasting about two minutes (which is about the time required for the suckers to bend over and fix themselves to the object held by the pedicellariæ, if such should be a suitable one) this wonderfully tenacious grasp is spontaneously released; and (3) that the most excitable part of the trident pedicellariæ is the inner surface of the mandibles, about a third of the way down their serrated edges, *i.e.* the part which a moving body cannot touch without being well within the grasp of the forceps.

When the forceps are closed they may generally be made immediately to expand by gently stroking the external surface of their bases.

With regard to stimulation of the spines, if severe irritation be applied to any part of the external or internal surface of an echinus, the spines all over the animal take on an active bristling movement. The tubercles at the bases of the spines are the most irritable points on the external surface.

With regard to stimulation of the pedicels, if an irritant be applied to any part of a row, all the pedicels in that row retract in succession from the seat of stimulation, but the influence does not extend to other rows. A contrary effect is produced by applying an irritant to any part of the external nerve-plexus, all the pedicels being then stimulated into increased activity. Of these antagonistic influences, the former, or inhibitory one, is the stronger, for if they are both in operation at the same time the pedicels are retracted.

Starfish (with the exception of brittle-stars) and echini crawl towards, and remain in, the light; but when their eye-spots are removed they no longer do so. When their eye-spots are left intact they can distinguish light of very feeble intensity.

Experiments in section showed that single rays detached from the organism crawl as fast and in as determinate a direction as do entire animals. They also crawl towards light, away from injuries, up perpendicular surfaces, and when inverted, right themselves. Dividing the ray-nerve in any part of its length has the effect of destroying all physiological continuity between the pedicels on either side of the division. Severing the nerve at the origin of each ray, or severing the nerve ring between each ray, has the effect of totally destroying all co-ordination among the rays, therefore the animal can no longer crawl away from injuries, and when inverted it forms no definite plan for righting itself. Each ray acting for itself, without reference to the others, there is as a result a promiscuous distribution of spirals and doublings, which as often as not are acting in antagonism to one another. This division of the nerve usually induces, for some time after the operation, more or less tetanic-like rigidity of the rays. This operation however, although so completely destroying physiological continuity in the rows of pedicels and muscular system of the rays, does not destroy or perceptibly impair physiological continuity in the external nerve-plexus; for however much the nerve-ring and nerve-trunks may be injured, stimulation on the dorsal surface of the animals throws all the pedicels and muscular system of the rays into active movement. This fact proves that the pedicels and the muscles are all held in nervous connection with one another by the external plexus, without reference to the integrity of the main trunks.

If a cork-borer be rotated against the external surface of an echinus till the calcareous substance of the shell is reached, and therefore a continuous circular section of the overlying tissues effected, the spines and pedicellariæ within the circular area are physiologically separated from those without it, as regards their local reflex irritability. That is to say, if any part of this circular area is stimulated, all the spines and pedicellariæ within that area immediately respond to the stimulation in the ordinary way, while none of the spines or pedicellariæ surrounding the area are affected, and conversely. Therefore it is concluded that the function of the spines and pedicellariæ of localising and gathering round a seat of stimulation is exclusively dependent upon the external nervous plexus. If the line of injury is not a closed curve, so as not to produce a physiological island, the stimulating influence will radiate in straight lines from its source, but will not irradiate round the ends of the curve or line of injury.

Although the nervous connections on which the spines and pedicellariæ depend for their function of localising and closing round a seat of stimulation are thus shown to be completely destroyed by injury of the external plexus, other nervous connections, upon which another function of the spines depends, are not in the smallest degree impaired by such injury. This other function is that which brings about the general co-ordinated action of all the spines for the purposes of locomotion. That this function is not impaired by injury of the external plexus is proved by severely stimulating an area within a closed line of injury on the surface of the shell; all the spines over the whole surface of the animal then manifest their bristling movements, and by their co-ordinated action move the animal in a straight line of escape from the source of irritation.

We have, therefore, to distinguish between what may be called the local reflex function of the spines, which they show in common with the pedicellariæ, and which is exclusively dependent upon the external plexus, and what we may call the universal reflex function of the spines, which consists in their general co-ordinated action for the purposes of locomotion, and which is wholly independent of the external plexus. Evidently, therefore, this more universal function must depend upon some other set of nervous connections (which, however, the authors were not able to detect histologically), and experiment shows that these, if present, are distributed over all the *internal* surface of the shell. For if the internal surface be painted with acid, or scoured out with emery paper and brick-dust, the spines and pedicellariæ, after a short period of increased activity or bristling, become perfectly quiescent, lie flat, and lose both their spontaneity and irritability. After a few hours, however, the spontaneity and irritability of the spines return, though in a feeble degree, and also those of the pedicellariæ in a more marked degree. These effects take place over the whole external surface of the shell, if the whole of the internal surface be painted with acid or scoured with brick-dust; but if any part of the external surface be left unpainted or unscoured, the corresponding part of the external surface remains uninjured. From these experiments it is concluded:—(1) that the general co-ordination of the spines is wholly dependent on the integrity of the hypothetical internal plexus, (2) that the hypothetical internal plexus is everywhere in intimate connection with the external, apparently through the calcareous substance of the shell; and (3) that complete destruction of the former, while profoundly influencing through shock the functions of the latter, nevertheless does not wholly destroy them.

Echini may be divided into pieces, and the pedicels, spines, and pedicellariæ upon these pieces will continue to exhibit their functions of local reflex irritability, however small the pieces may be. If an entire double row of pedicels be divided out as a segment and then placed upon its aboral end, it may rear itself up on its oral end by the successive action of its pedicels, and then proceed to crawl about the floor of the tank. We have therefore to meet the question: Is the action of the ambulacral feet in executing these righting movements of a merely serial kind, *a*, *b*, and *c* first securing their hold on the tank floor, owing to the stimulus supplied by contact, and then by their traction tilting over the globe, till *d*, *e*, and *f* are able to touch the floor, and so on, *or* does the righting action depend upon nervous co-ordination? Experiments showed that both principles are combined, the action of the pedicels being serial, but also assisted by nervous co-ordination. This conclusion is sustained by the experiment of shaving off the spines and pedicels over one-half of one hemisphere, *i.e.* the half from the equator to the oral pole. When then inverted and forced to use their mutilated pedicel rows, the echini reared themselves upon their equators, and then, having no more pedicels wherewith to continue the manœuvre, came to rest. This rest was permanent, the animal remaining, if accidents were excluded, upon its equator till it died. The question then here seems to resolve itself simply into this: Is the mechanism of the pedicels so constructed as to insure that their serial action shall always take place in the same direction? For if it can be shown that their serial action may take place indifferently in either direction it would follow that the persistency with which the partly shaved echini continue reared upon their equators, is the expression of some stimulus (such as a sense of gravity) continuously acting upon some central apparatus, and impelling the latter to a continuous, though fruitless, endeavour to co-ordinate the absent pedicels. If the pedicels are able to act serially in either direction, there is no more reason why a partly-shaved echinus should remain permanently reared upon its equator, than that it should remain permanently inverted upon its pole; and therefore the fact that in the latter position the pedicels set about an immediate rotation of the animal, while in the former, and quite as unnatural position, they hold the animal in persistent stasis—this fact tends to show that the righting movements of the pedicels are something more than serial. Thus the whole question as between the two hypotheses amounts to whether the pedicels are able to act serially from oral to aboral pole. Observation showed that they are so, for echini spontaneously rear themselves from their normal position on the oral pole, to the position of resting upon their equators. Further, as additional evidence that the righting movements are at least assisted by some centralising influence, is the fact that when the evolution is nearly completed by the pedicel-rows engaged in executing it, the lower pedicels in the other rows become strongly protruded and curved downwards, in anticipation of shortly coming into contact with the floor of the tank.

Removing the pentagonal nerve-ring has no effect at all upon the pedicellariæ or on the local reflex action of the spines; both these organs continue to close round an instrument of stimulation. But the general co-ordination of the spines is totally and permanently destroyed—their bristling movements no longer serving to convey the animal from a source of irritation, but only causing the animal aimlessly to gyrate. This shows that the pentagonal nerve-ring has in large measure the function of a nerve-centre. The same thing is shown by the effect of its removal upon the righting movements. These are gravely impaired, though not wholly destroyed—four in twelve specimens so mutilated continuing able to right themselves. These facts, together with the fact of separate segments of echinoderms behaving in all respects like entire animals, prove that the nervous system is in function, as in structure, everywhere both central and peripheral, although the impairing influence exerted on the co-ordination both of the spines and pedicels by removal of the pentagonal ring, proves that this ring has a more centralising function than any other part of the nervous system.

Chemical Society, March 30.—Anniversary Meeting.—The president, Prof. Roscoe, gave his annual address. He congratulated the Society on its flourishing condition. At no period in its history had the number of Fellows been so large, whilst the number of papers read during the past twelve months had increased both in number and in importance. The research fund founded by Dr. Longstaff had done much for the progress of science. The President touched upon the more important discoveries of the year. The supposed decomposition of chlorine and iodine by Victor Meyer has been found to be capable of another explanation. The solar and stellar evidence of the decomposition of metals accumulated by Mr. Lockyer has not yet found general acceptance by chemists. Capt. Abney and Col. Festing have discovered that the organic radicals methyl, ethyl, &c., give characteristic absorption spectra in the infra-red part of the spectrum. Baeyer has succeeded in preparing indigo artificially, and its manufacture on the commercial scale is rapidly progressing. The Society has lost by death ten Fellows, including Sir B. Brodie, Dr. Stenhouse, Prof. W. H. Miller, and Mr. Tennant.—The Longstaff medal was presented to Prof. Thorpe of the Yorkshire College, Leeds, as the Fellow who had done the most to promote chemical science by research.—The reports of the President and Treasurer were received and adopted, and the Officers and Council elected for the ensuing year. President, H. E. Roscoe. Vice-Presidents: F. A. Abel, Warren De La Rue, E. Frankland, J. H. Gladstone, A. W. Hofmann, W. Odling, Lyon Playfair, A. W. Williamson, A. Crum Brown, J. Dewar, J. H. Gilbert, A. V. Harcourt, J. E. Reynolds, J. Young. Secretaries: W. H. Perkin, H. E. Armstrong. Foreign Secretary, Hugo Muller. Treasurer, W. J. Russell. Council: F. D. Brown, M. Carteighe, H. McLeod, G. H. Makins, E. J. Mills, W. C. Roberts, C. Schorlemmer, J. M. Thomson, C. M. Tidy, W. Thorp, T. E. Thorpe, R. Warington.

Physical Society, March 26.—Prof. Fuller in the chair.—New member Mr. Lewis Wright, author and editor.—Dr. James Moser read a paper on electrostatic induction, especially relating to the branching of the induction in the differential inductometer and in the electrophorus. The author's experiments bore out the hypothesis of induction as enunciated by Faraday. Prof. Ayrton suggested the importance of adding guard-rings to the small plates of the five-plate inductometer or balance, since without these mathematical calculations could not be accurately applied, and the experimental determination of specific inductive capacity would be doubtful. Dr. Moser pointed out that though the theory was not absolutely correct it lay with the experimenter to get results very approximately correct.—Prof. Reinold, one of the secretaries of the Society, read a paper by himself and Prof. Ruckert on the electrical resistance of liquid films with a revision of Newton's scale of colours. The experiments were in continuation of those published by the authors in 1877. Their object was to determine whether a film thinning under the action of gravity gave any evidence, by a change in its specific resistance, of an approach to a thickness equal to twice the radius of molecular attraction, and also to devise a method of finding the amount of water which might be absorbed by or evaporated from it. The thickness of the films was determined from their colour by means of two beams reflected from different mirrors on them.—Newton's scale of colours was revised by observations on Newton's rings, and partly by more than 2000 observations on the rings themselves. The thicknesses determined by direct observations on Newton's rings and those in the corrected table rarely differ by 1 per cent., while Newton's scale in parts differs from both by as much as 10 per cent. of the thickness. The films were formed from a solution of oleate of soda in glycerine, with a little nitrate of potash added to increase their electric conductivity. They were blown in a glass case from which the outer air could be excluded. Precautions were taken to keep the air in contact with the films inside the case at a proper humidity. These consisted in placing disks containing the solution at the bottom of the case and suspending within it sheets of blotting-paper, the lower edges of which dipped into the liquid. A hair hygrometer indicated changes in the humidity of the interior. The resistance of the films was measured by piercing them with gold wires, which were connected with the electrodes of a quadrant electrometer. The resistance of the film between the needles was calculated by comparing the deflection caused by the difference of potential of the two wires when a current was passing through the film with that produced by the difference of potential above and below a known resistance placed in the same circuit. The specific resistance of the liquid from which the films were formed was measured by a method identical in principle with the above. The liquid was contained in a glass tube with turned-up ends. Platinum wires were cemented into small holes drilled in the straight part of the tube, and their difference of potential compared with that of two points in the same circuit separated by a known resistance. This method has the great advantage of getting rid of any difficulties connected with polarisation. Test experiments on sulphuric acid proved the method to give results agreeing with those of Kohlrausch, who employed alternating currents and Wheatstone's bridge. The results of the experiments may be summed up as follows:—It is difficult to form a soap film under conditions precluding a slight evaporation or absorption of water, but the more nearly these conditions are attained the more closely does the specific resistance of the film agree with that of the liquid in mass. The films observed under the most favourable conditions obeyed Ohm's law with great accuracy, and much better than the others. The films indicate no approach to a thickness equal to the diameter of molecular attraction. A soap film may even in an inclosed space readily loose 23 out of 57·7 volumes of water contained in every 100 volumes of the solution, when special precautions are not taken to maintain the surrounding space in a constant hygrometric condition. Prof. Ayrton suggested that in measuring the liquids and film the distance between the electrodes should be varied. Prof. Guthrie pointed out that the results of Prof. Reinold and Kohlrausch agreed with his own in showing that the conductivity of liquids obeyed Ohm's law.

Geological Society, March 23.—Robert Etheridge, F.R.S., president, in the chair.—Rev. Daniel Dutton and Capt. George Ernest A. Ross were elected Fellows of the Society.—The following communications were read:—The Upper Greensands and chloritic marl of the Isle of Wight, by C. Parkinson, F.G.S. In this paper the author described the Upper Greensand as exposed at St. Lawrence and along the Undercliff. At the base of the St. Lawrence Cliff there are hard bands of blue chert from which astaciform Crustacea have been obtained; and quite recently, in a large boulder of the same material lying on the beach, there were found the remains of a Chelonian, referred by Prof. Owen to the family Paludinosa, and named by him *Plastremys lata*. The presence of these freshwater organisms was thought to imply a connection with the Wealden continent. The chert bed, 2 feet thick, was regarded by the author as marking the boundary between the Gault and the Greensand. Above it the author described 56 feet of compact red and yellow sands, of which the first 20 feet are unfossiliferous, the upper 32 feet show traces of organic remains; between them there is a fossiliferous zone 4 feet in thickness, containing *Ammonites inflatus*, *A. auritus*, and species of *Panopæa*, *Cucullæa*, *Arca*, and *Trigonia*, and immediately below this a separate band containing an undetermined species of Ammonite. These sands are followed by 38 feet of alternate beds of hard chert and coarse greensands, having at the bottom 6 feet of inferior building-stone surmounted by 5 feet of freestone. The latter contains *Ammonites rostratus*, and the cherts various fossils, chiefly bivalves. *Clathraria Lyelli* also occurs at this level. Above the greensands come 6 feet of chloritic marl: the upper 3½ feet fossiliferous, with a base of hard phosphatic nodules containing crushed specimens of *Pecten asper*; the lower 2½ feet compact, with darker grains and few fossils. The author compared the sections of

this series given by Capt. Ibbetson and Dr. Barrois; his own views closely correspond with those of the latter writer.—On the flow of an ice-sheet, and its connection with glacial phenomena, by Clement Reid, F.G.S. The author considers that the boulder-clays have been formed beneath an ice sheet, and consequently there must have been formerly a huge mass of ice, which would have to flow 500 miles on a nearly level surface, and then to ascend a gentle slope for nearly another 100 miles. He does not think a great piling up of the ice at the North Pole can be assumed to account for this motion. This he explains by the gradual passage of the earth's heat through the mass of ice, *raising* the temperature of the whole instead of *liquefying* the surface-layer. As the heat passes upwards it raises the temperature of a particular layer, causes it to expand, and so to put a strain upon the layer above, and then to rupture it. The broken part spreads out, reunites by regelation, and then, receiving the heat from the layer below, again expands and ruptures the layer next above. Thus the movement is from the base upwards rather than from the surface downwards. The author estimates that the ice-sheet in Norfolk was only about 400 feet thick, because boulder-clay does not appear above that level, but only coarse boulder-gravel; in North Yorkshire it extends up to about 900 feet. The author considers that the shell-beds of Moel Tryfaen were not deposited under water, but thrust up-hill by this advancing ice sheet.—Soil-cap motion, by R. W. Coppinger, communicated by the president. The author described numerous cases in Patagonia where the stumps, &c., of trees are to be seen in the marginal waters of the sea and of lakes. These, together with stones and rocks, sometimes simulating perched blocks, he considers to have been brought down by the motion of the soil-cap—a thick spongy mass resting upon rock often worn smooth by the action of ice, and so sliding down the more easily under the influence of vegetation. The appearances are not unlike those due to subsidence, but he points out that all the evidence is in favour of recent upheaval, instead of subsidence.

Victoria (Philosophical) Institute, April 4.—Prof. Balfour Stewart, F.R.S., read a paper on the visible universe, which he described in general terms, and then sought to trace its history back, giving a passing sketch of the views of the theologian on the one hand and the materialist on the other, through its many forms to its first logical origin. A discussion ensued, which was taken part in by several who had been specially invited, the question being treated from the scientific and the metaphysical point of view.

PARIS

Academy of Sciences, March 28.—M. Wurtz in the chair.—On account of the death of M. Delesse, the Academy went early into Secret Committee.—The following papers were communicated:—On the heats of formation of diallyl, chloro-compounds, and aldehyde, by MM. Berthelot and Ogier.—Remarkable case of globular lightning, diffuse flashes near the surface of the ground, by M. Trécul. On August 25, 1880, during a thunderstorm, and in full daylight, he saw a very brilliant body, slightly elongated (say 38 to 40 ctm. long by 25 ctm. broad), and with conical ends, pass from one part of a dark cloud to another; and before disappearing, a small part of its substance fell, *as if having weight*, and gave a luminous vertical track with reddish globules at the sides. It divided in falling, and disappeared a little above the house. The other phenomenon M. Trécul has often noticed in thunderstorms, viz., a band of feeble light, momentarily illuminating a street and reaching right across it, or only part of the width. The author adds some reflections on the phenomena he described on August 23, 1880.—On the representation of numbers by forms, by M. Poincaré.—On a class of linear differential equations, by M. Halphen.—On the reduction of positive quaternary quadratic forms, by M. Charve.—New researches on the winter egg of phylloxera; its discovery at Montpellier, by M. Mayet. To find the winter egg in Languedoc, he recommends searching on young American vines of the species *Riparia*, and only where galls are observed on the leaves; further, only raising the bark of two or three years (preferably the former).—Attempted application of the principle of Carnot to electro-chemical actions, by M. Chaperon.—On the construction of photophonic selenium receivers, by M. Mercadier. These consist of two strips of brass (1 to 4 or 5m. long) separated by two strips of parchment paper, the whole wound in a close spiral, and held in position by two wooden pieces with screws. The arrangement is heated to the melting-point of selenium, and a pencil of selenium passed over the surface. These receivers are continuous, are easily made and repaired, have the same properties as the discontinuous ones, &c. It is possible to give them a very variable resistance, from 8000 to 200,000 ohms., without their ceasing to act well. A large number arranged in series or in surface may be placed in the battery circuit, and many persons enabled to hear photophonic effects at once. In one of M. Mercadier's arrangements the sounds were heard at 2 or 3 m. distance.—On the causes of disturbance of telephonic transmission, by M. Gaiffe. He notices the disturbing effects of friction of wires with each other, and of vibrations caused by wind or otherwise.—On the preparation and the properties of protochloride of chromium, and of sulphate of protoxide of chromium, by M. Moissan.—On phosphoplatinic combinations, by M. Pomey.—Products of action of hydrochlorate of ammonia on glycerine, by M. Etard.—Irian grafts; pathogeny of cysts and epithelial tumours of the iris, by M. Masse. He has found (with rabbits) that small pieces of the conjunctiva or of skin introduced into the anterior chamber of the eye, through an incision made in the cornea, are pretty easily grafted on the iris. After some time the graft takes the form of a fine small pearl, very like the cysts or epithelial tumours which sometimes appear on the human iris after wounds of the cornea. The grafts with skin consist of a thick layer of pavement epithelium, with connective tissue beneath united to that of the iris. In the centre of the grafts of conjunctiva a true cystic cavity is developed. Hairs with their follicles may also be grafted on the iris. Rothmund's theory of the cause of cysts and tumours of the iris (pieces of skin, &c., carried through a wound) is apparently verified by these researches.—On the nature and order of appearance of old eruptive rocks observed in the region of volcanoes with craters of Puy-de-Dôme, by M. Julien.

VIENNA

Imperial Academy of Sciences, March 31.—V. Burg in the chair.—The following papers were read:—H. Wild, on the temperatures of the Russian Empire.—Dr. H. Goldschmidt, on the action of molecular silver on carbon chlorides.—Dr. F. Hocevar, on some experiments made with a Holtz's machine.—R. Andrasch, synthesis of methylated parabanic acid, of methyl thioparabanic acid, and of thiocholestrophane.—Dr. Emil Holub and A. v. Pelzeln, ornithological results of Holub's voyages in South Africa.—Kachler and Spitzer, on Borneol- and camphor-carbonic acid.—Max Groger, on sulphochromates.—Alb. Cobenzl, contribution to the dissociation of tungsten from antimony, arsenic, and iron, with an analysis of a so-called pseudo-meteor.

CONTENTS

THURSDAY, APRIL 14, 1881

THE NEW MUSEUM OF NATURAL HISTORY

THE great terra-cotta building facing Cromwell Road, South Kensington, and occupying the site of the old 1862 Exhibition, about which for the past twelve months public curiosity has been raised, is about to draw up its blinds, and to offer a part of its extensive galleries for inspection on Easter Monday

It is no secret that for thirty years past the accommodation in the British Museum, Great Russell Street, Bloomsbury, "both for man and beast," had become too restricted, and the necessity for a larger building was keenly felt. As usually happens in such cases, the most adventurous and energetic officer was the first to obtain for his department what he required, namely, *more room*

Sir A Panizzi (then Keeper of Printed Books) projected, shortly after the 1851 Exhibition, his scheme for a great central Reading-room and Library, and some five years after witnessed its completion. Some years later on, the Department of Antiquities, represented by Mr C T Newton, C B, also obtained an addition to its galleries on the western side, and still more recently on the southern side, next the great Entrance Hall.

Great praise is due to Mr Bond, the present Principal Librarian, for putting an end to the use made of the fine colonnade in front of the British Museum, which for twenty-five years was blocked by antiquities covered in with a row of extremely unsightly and incongruous wood and glass sheds These are now happily removed The Department of Prints and Drawings lacking a gallery, obtained possession of the "King's Library" floor on the east side for an exhibition space, and even the conservative Coin Department likewise laid out for the public a few show-cases here of coins and medals

But, like the clothes of the rising son, in the old caricature, the collections everywhere had outgrown their receptacle, and none more so than the departments of Natural History Scientific men were however not unanimous, and a fierce controversy was carried on in 1858-59 as to the relative merits of enlargement on the old site, or dismemberment Finally, after a Committee of the House of Commons had taken evidence upon the subject, the removal of the Natural History Collections was decided upon by Government

But the death of the Prince Consort, the delay of the House of Commons to vote the necessary funds, the retirement of Sir A Panizzi from the post of Principal Librarian, the discussion of rival plans, the inevitable delays about the completion of any Government building, caused twenty years to pass before the plans of the chosen architect, Mr. Alfred Waterhouse, were realised in a solid and material form

Midsummer, 1880, barely sufficed to enable the Office of Works to certify to the fulfilment of the Contractor's work and to hand over the building to the Trustees ere collections began to be moved in

Nine months only have elapsed, and already three Departments, viz. Botany, Mineralogy, and Geology, have transferred their entire collections from the old to the new building But less than half the cases for the entire building have yet been supplied, and everywhere the labour of completing the structure as well as fixing cases and fittings is being busily carried on Under these circumstances it seems not improbable that two years may elapse before the Zoological Collections will be removed and housed in their new quarters

Let us now take a glance at what Mr. Sala styles "this Temple of Nature" The architectural character of the new building may be termed "Decorated Norman," but it is in many respects unique, especially as regards the treatment of its details The first, or "ground-floor," is above the road, and the entrance is approached by a broad flight of steps and by a sloping carriage-drive. The entire structure is of brick cased with terra cotta, the doorways and the windows being ornamented with columns designed from natural history objects, chiefly from plants. Reproductions of various animals are also introduced The main part of the building has a tower at each end, and there are also two central towers rising on either side of the entrance The south front of the building is about 650 feet in length, running due east and west, and is three storeys high, in addition to the basement, which is above the level of the garden in which the building stands

The Central Hall or "Index Museum" runs from south to north, it is 150 feet long, 97 feet wide, and about 60 feet high, along its two sides are twelve arched recesses. At the north end is a wide and handsome staircase which branches off right and left to the open corridors or side aisles on either hand upon the first floor This Central Hall is more richly decorated than any part of the building The floor of mosaic work, where Italian marble is employed, has been skilfully laid by Italian workmen The side aisles or corridors look out into the Central Hall by an open balustrade surmounted by large arches, each containing three smaller ones, the centre one being much higher than the others. The pillars supporting these are ornamented with a nearly natural treatment of *Lepidodendron*, in some few cases animals, monkeys, birds, &c, are introduced The decoration of the ceiling is very effective. A double row of panels runs along the central line, and on either side of this, between the iron girders and following the curve of the roof, are panels in groups of six, these are ornamented with representations of different species of trees, shrubs, and flowering-plants treated somewhat conventionally That portion of the ceiling over the main body of the hall is decorated with trees, each of which occupies six panels, as they can be most easily seen from the floor and need bold treatment. At the south end, where the ceiling is over a staircase and landing leading from the first to the second floor, each panel contains but one species · the eye being nearer to the ceiling greater detail has been introduced The effect of the whole is very fine, and as the hall is at present without any cases or specimens, it has the general appearance of a cathedral This idea is further heightened by the introduction of a triforium, though this has been added merely for effect, the passages being interrupted

Beyond the Index Museum is a smaller and less lofty hall quite divided from it, save by two arched entrances, 97 feet by 70 feet, intended to hold the British Zoological Collection. It is surrounded by arched recesses similar to those in the Index Museum. In this hall the decora-

tion of the ceiling is also botanical, but all the species selected are of British plants. Underneath the staircases and in the recesses a plain light colour is introduced, relieved with gilding The decorations of the saloons or galleries are much simpler The columns throughout are of terra cotta, ornamented with natural history objects

The other parts of the building consist of series of galleries running north from the front or main building, but only one storey above the basement The rooms on each floor, at the end of the long front galleries and under the two end towers, are called pavilions The main or front galleries facing Cromwell Road are lighted by windows north and south The Central Hall or Index Museum, the Hall for British Zoology, and all the other galleries of one storey high running north, are lighted by skylights The Index Museum has however, in addition to its roof-lights, windows in the corridors on either side

The distribution of the space available is as follows — The long galleries to east of the entrance on the ground-floor, and all the galleries from it, running north, are devoted to Geology and Palæontology The first floor above the Geological Gallery is devoted to Mineralogy, and the floor above this to Botany. The whole of the galleries on the west side of the building are given to Zoology The Index Museum, according to Prof Owen, is designed to present to the public, in a series of twelve recesses, typical examples of all the collections—in fact, an epitome of the whole animal, vegetable, and mineral kingdoms Prof. Owen further desires to show the marvels of nature and objects of special interest, as exemplifying size, &c, such as whales, basking sharks, &c These are to occupy the centre of this great hall Passing to the right from the Index Museum (on the ground floor) we enter the South-East Gallery of the Geological Department (233 feet in length by 50 feet in width, and lighted by windows on either side), at the east end of which is the Pavilion, a room 60 feet by 40 feet. These two galleries are entirely devoted to the exhibition of the fossil Mammalia and Birds, and are provided with pier-cases and table-cases The larger objects are arranged down the centre of the floor.

The cases on the left hand are nearly all occupied with the remains of *Proboscidea* Commencing with the *Deinotherium* from Eppleshein, with its tusk-like incisors in the lower jaw, we pass to the *Mastodons*, in which, as a rule, the tusks are developed in the upper jaw and not in the lower. But to this there are exceptions, one American Mastodon having immature tusks in the lower jaw, and the *Mastodon augustidens*, from Sansau in France, having tusks in both the upper and the lower jaw

Nearest the entrance door, in the centre of the gallery, is placed the entire skeleton of the great American mastodon from Ohio, which must have been considerably larger in bulk than that of any existing elephant, on the same stand is placed the head of a young Mastodon from New Jersey, and in front of it the skull and lower jaw of the South American Mastodon from Chili It is interesting to notice that both the mastodon and elephant had overspread the North and South American continents in Tertiary times, and they were equally widely distributed over the European and Asiatic continents; their modern representatives however are confined, the one to the continent of Africa, the other to India, Ceylon, &c. The tusks of some of the old fossil elephants were of enormous proportions · witness the head of *Elephas ganesa* from the Siwalik Hills, India, and that of the mammoth (*Elephas primigenius*) from the valley of the Thames, near Ilford Large numbers of elephant remains have been dredged up year by year for the past sixty years off the Dogger Bank and the Norfolk coast, affording good evidence that in comparatively modern times the North Sea was a great valley watered by the Rhine, Moselle, &c, giving pasturage to vast herds of deer, bison, oxen, and elephants, where also the rhinoceros and the hippopotamus found a pleasant home. A goodly series of the remains of these animals from British and Continental localities may be seen in this gallery, and also abundant evidence of the old Siberian mammoth and rhinoceros, both of which have been met with "in the flesh," frozen solid in mud and ice Here are also exhibited an interesting series of the "pigmy elephant" from Malta, brought home by Admiral Spratt, R N, and Prof. Leith Adams By far the larger collection of elephant remains are those from the Siwalik Hills, India, obtained by Col Sir Proby T Cautley and described by Dr Hugh Falconer, F R S The "gigantic Irish deer" (*Megaceros Hibernicus*) forms a prominent and striking object in the centre of the gallery, with its branching antlers 10 feet across, a noble prey for its contemporary, the "sabre-toothed tiger" (*Machairodus latidens*), remains of both animals having been found together in Kent's Cavern, Torquay

Passing by the cases of carnivora, of thick-skinned animals, and of ruminants, our attention is next arrested by the great bandless armadillo from South America (*Glyptodon*), whose carapace is bigger than a hogshead, and which measured nearly 12 feet from its head to the tip of its armour-plated tail

Another of these extinct Edentates from the La Plata, the *Megatherium Americanum*, stands in the centre of the floor of the Pavilion This colossal "ground-sloth" measured 18 feet in length, its bones being more massive than those of an elephant It displays in every part of its framework enormous strength and weight combined, sufficient to break down or uproot the trees, upon the leaves and succulent branches of which it fed, like its pigmy modern congener *Bradypus tridactylus*, which leads an arboreal existence, climbing from bough to bough in the Brazilian forests

The extinct Marsupial fauna of the great island continent of Australia is here well represented by the huge *Diprotodon*, the *Nototherium*, and the anomalous *Thylacoleo* Of the Wombat family only a small living representative is known, of burrowing habits, found in Tasmania, formerly they were abundant on the continent of Australia, varying in size from a marmot to that of a tapir The largest of these are called *Phascolomys magnus* and *P gigas*

The collection of remains of the great extinct wingless birds of New Zealand forms a very interesting feature of this gallery. The tallest skeleton measures 12 feet in height, and the smallest not more than 3 feet

Madagascar had also its extinct wingless birds, similar to those of New Zealand. Eggs of both the *Dinornis* and the *Æpyornis* may here be seen, one of the latter having a capacity of two gallons.

The rarest of all avian fossils is still the *Archæopteryx*

macrura from the lithographic stone quarries of Solenhofen. Fortunately for the incredulous a second specimen has recently been obtained, and is preserved in the Berlin Museum. Its lacertilian affinities are well shown in its long and rat-like tail of twenty vertebræ and its three-clawed digits in each fore-limb (or wing?) The head of the Berlin specimen is too obscure to give evidence of teeth, but its beaked jaws are clearly seen in the photograph The original specimen described by Prof Owen is headless

Running parallel with the south-east gallery is the Reptilian Gallery, 225 feet in length and 21 feet wide, the south wall of which is entirely occupied with the grand series of sea-lizards, the *Ichthyosauria* and *Plesiosauria*, once so abundant in the old Liassic seas of Europe, and the fossil remains of which have even been brought home from the Arctic regions and from New Zealand The largest of the long-necked Plesiosaurs measures 22 feet in length and 14 feet across its extended paddles The largest Ichthyosaur was probably even bigger than this On the north side are displayed the remains of the great land lizards, *Dinosauria*, of which the *Iguanodon* is perhaps the most familiar example A more recent discovery is that of the *Omosaurus* from the Kimmeridge Clay of Swindon, Wilts, the femur of which is more than 4 feet in length, and the humerus nearly 3 feet long, and enormously broad, they were probably to some extent amphibious in their habits, but their limbs were well fitted for progression on the land.

Numerous other fine Dinosaurian remains are to be seen in these cases As we do not know the teeth of many of these huge reptiles, we are unable to speak positively as to their habits, but it is certain that from the Trias to the Chalk two groups have existed side by side, one having a carnivorous dentition and the other being herbivorous. The *Teratosaurus* of the Trias of Stuttgart and the *Lycosaurus* and *Cynodraco* from the Cape, the *Megalosaurus* of the Stonesfield Slate and Wealden were all carnivores, whilst the *Iguanodon*, *Acanthopholis*, *Scelidosaurus*, and the South African genera *Anthodon* and *Nythosaurus* were all vegetable-feeders. But of *Polacanthus*, *Omosaurus*, *Hylæosaurus*, and *Cetiosaurus* we have no direct dental evidence. No doubt, as amongst the mammalia at the present day, the majority were vegetable-feeders and the minority were predacious in habit.

In this gallery are also exhibited the flying lizards of the Secondary Rocks, most of which have been found in the lithographic stone of Solenhofen and a few in our own Lias, Stonesfield Slate Chalk, and Greensand

If Comparative Anatomy may be trusted, some of the Pterodactyles from the Chalk of Kent give evidence of a flying lizard having probably an expanse of wings of from eighteen to twenty feet.

An Australian novelty is the great horned lizard (*Megalania prisca*), 14 feet or more in length, with nine horn-like prominences on its skull and an armour-plated tail similar to that of the *Glyptodon*

The Triassic reptiles from South Africa form a singular addition to our knowledge of ancient life forms long since passed away They are comprised in Prof Owen's groups of *Anomodontia* and *Theriodontia*.

Among the fossil Chelonians we have representatives of both the marine turtles, the fresh-water *Trionyx* and *Emys*, and the gigantic and lesser land-tortoises. Of the first of these are the remains of the great *Chelone Hofmanni* from Maestricht, and the *Chelone gigas* from the London Clay of Sheppey, larger by far than the "loggerhead" turtle of the present day. Of the last (land-tortoises) may be mentioned the *Colossochelys atlas* from the Siwalik Hills, which out-rivals the *Glyptodon* in bulk.

Three wide and four narrow galleries built at right angles to the Reptile Gallery, each 137 feet in length, the former being 40 feet and the latter 20 feet in width, are placed alternately, running due north and south, and lighted from above. These fine rooms afford ample accommodation for the fossil fishes, all the classes of the Invertebrata (mollusca, brachiopoda, bryozoa, insecta, myriopoda, arachnida, crustacea, annelida, echinodermata, corals, foraminifera, sponges, and plants). These long galleries, or annexes, and the ones corresponding with them on the western side, are built upon the plan recommended by the Royal Commission of 1874. But the wall-cases are all constructed to open in front, *not at the back* of the case, as suggested They are however the best-lighted galleries in the whole building, and best suited for museum purposes Two of these large galleries are not yet ready for occupation, and the third is under arrangement, the narrow galleries give space for a library, special reference collections, a stratigraphical series, and working-rooms for students

In the basement are twelve workshops, studies, and store-rooms devoted to Geology, ten studies, work-rooms, and laboratories to Mineralogy, and three to Botany

The Mineralogical Gallery, on the first floor, which corresponds with the South-East Gallery and Pavilion in extent, is also lighted by windows on either hand, it has seven wall-cases, two at each end of the long gallery and three in the Pavilion, the collection being mainly contained in forty-eight large table-cases

These table-cases form a long row on either hand, commencing at the entrance of the gallery, the odd numbers being on the left hand and the even on the right Each of the first forty cases nearly equals in capacity two of the cases in the old mineral gallery, we have therefore a much more magnificent display than could have been attempted formerly, when the minerals and fossils were all crowded together in the same gallery.

The collections of naturally and artificially-prepared crystals occupy two large cases in the Pavilion, whilst two of similar construction are filled with meteorites. The great Cranbourne Meteorite and that from Mexico occupy special cases on the east side In the wall-cases are arranged the extensive collection of rocks, two cases being devoted to polished marbles.

The general plan pursued in the arrangement remains the same as in the old Museum gallery, so that by using boxes corresponding to one quarter of a table-case, the minerals were transported from the old to the new building and re-arranged in an incredibly short space of time, and with the exception of the Pavilion and the wall-cases have long been ready for exhibition

In the Botanical Gallery the glazed cases for the exhibition of specimens project from the wall into the room like square shop-fronts, having three plate-glass sides. The whole of the glass is permanently fixed, except one

division forming the door A "cell" inside, inclosed by curtains, gives access to the specimens; by this contrivance it is hoped that the dust will be excluded to a great extent.

Accommodation for large specimens, as, for example, portions of stems and sections of various kinds of wood, such as oak, walnut, pine, cedar, and other dicotyledons, and trunks of palms, cycads, tree-ferns, bamboos, and other striking examples of the vegetable kingdom, is provided for by three tall metal and glass cases 14 feet high, occupying the floor-space in the centre of the gallery.

One-half of the main gallery is partitioned off from the public room, and fitted up with cabinets for the reception of the *Herbarium*, the nucleus of which was obtained by Sir Joseph Banks and Solander in their voyage round the world with Captain Cook. This first series of cabinets is entirely occupied with the flowering plants, which are all fastened on single sheets of paper. The Pavilion contains similar cabinets for the reception of the British plants and Filicinæ, whilst the room above in the tower is intended for the Cryptogamia. Down the centre of the large room are cabinets fitted to receive the great collection of fruits and seeds, each being placed near its appropriate family in the Herbarium on either side. These inner rooms, with the valuable library attached to them, are of course only available for purposes of study, but are always accessible to the botanical student and worker.

On the south-west side of the Index Museum, the gallery on the second floor which corresponds with that appropriated to Botany is designed to contain the great collection of Recent Osteology; that on the first floor is to be devoted to stuffed animals, and the front ground-floor gallery to birds. The eight galleries in rear of the main building on the west side will be appropriated to the Reptilia, Fishes, and Invertebrata. The collections preserved in spirits are to be placed in a special building at the north end of these galleries. The basement on the west side contains sixteen studies and work-rooms and a large open space well fitted for workshops and stores.

The Assistant-Secretary (Mr. J. T. Taylor) is provided with offices adjoining the Board Room on the first floor above the British Zoological Hall. The Superintendent, Prof. Owen, C.B., and the Keepers of Geology (Dr. H. Woodward, F.R.S.), of Mineralogy (Mr. L. Fletcher, M.A., F.G.S.), and of Botany (Mr. W. Carruthers, F.R.S.), have each a study in the central towers on either side the entrance.

There are a few scientific men who still strongly protest against the removal of the Natural History Collections from the old to the new building, on the ground that the locality is inconveniently far west, and that they are thereby precluded from using the Collections so freely as heretofore. One of the strong grounds for protesting against the removal has been the serious inconvenience arising from the separation of the collections from the great National Library. This injury will however be gradually removed by the formation of a new Natural History Library in the present building, a vote for which has been already taken.

The comparatively small band of scientific men who use the Natural History Museum for purposes of special work and study, would always do so wherever the collections happened to be located.

So too the holiday-makers, who come to the Museum merely to be amused, will as willingly travel to South Kensington as to the Regent's Park Zoological Gardens, or to the Crystal Palace.

Undoubtedly the highest aim and use of our great National Natural Historical Collections should be to impart instruction to the young and rising generation, and afford every facility for the advancement of our scientific students, and the question whether they are now conveniently placed is mainly for them to answer. If in the future South Kensington is to become a great centre of scientific instruction, then, and not otherwise, the Natural History Collections have been placed in their most suitable position.

We cannot conclude this hasty notice without stating that the old restrictions as to days of admission have all been swept away, and the collections will from and after the 18th be open daily to the public, save on Sundays, Christmas Day, and Good Friday, and other public fast days, &c.; good and cheap guide-books are also to be ready for the 18th.

For this and other concessions the public are mainly indebted to the untiring energy and determination of the present principal Librarian, Mr. Edward A. Bond, LL.D., who has also been the means of introducing many necessary and useful reforms into the old building; not the least being the electric light, which it may be hoped will ere long cast its beams over the collections in the Natural History Museum, Cromwell Road, South Kensington.

TEXT-BOOK OF MECHANICS

A Text-Book of Elementary Mechanics, for the Use of Colleges and Schools. By Edward S. Dana, Assistant Professor of Natural Philosophy in Yale College. (New York: John Wiley and Sons, 1881.)

THIS is a small-sized book of 290 pages printed in fairly clear type, and bound in an unpleasant-looking cover, and we learn from the preface that it has been prepared to meet the special wants of Yale College instruction. An endeavour has been made to dwell more fully than usual on the principles of the subject, at the same time illustrating these principles in their practical bearings by descriptions of various machines and appliances, while no mathematical knowledge beyond the rudiments of algebra and trigonometry is required. From this it may be presumed that the book is intended for a very elementary class of students, at a lower stage, if possible, than "Poll" men at Cambridge, or else that it aims at assisting self-education by supplying the place of a tutor. An undoubtedly good feature in the book is the collection of examples, some of which are interspersed in the text, and others collected in a body at the end, where the answers are given. The metrical and ordinary units are both employed. These examples are perhaps the only part of the book which would be of any value to teachers in this country. With regard to the main subject-matter of the book, Dynamics is placed first, and Statics follows, with a chapter on the Pendulum at the end. The definitions and the explanation of the principles of the subject, though aiming at fulness and clearness, are not always so satisfactory as might be wished. A tendency to looseness of expression sometimes counter-

balances the value of the fuller explanation. To explain *solidity* we are told that "A solid is characterised by a greater or less degree of rigidity," which in the absence of a separate definition of rigidity leaves us much where we were before Again, the definition of a *liquid* is this, "A liquid is characterised by its mobility, the molecules are free to move about each other, and the liquid takes the shape of any containing vessel," which is equally true of a *gas* The proof of the formula $S = \frac{1}{2}ft^2$ is clenched by the proposition that "when two sets of variable quantities, which are always equal, simultaneously approach their limits, these limits are equal," which is suddenly introduced without any explanation of its meaning This, in a book intended for beginners unacquainted with the idea of a "limit," would be likely to cause some bewilderment. There is a chapter devoted to Work and Energy, as should be the case with all text-books of mechanics nowadays.

In the dynamical section there is an entire omission of "Sliding in Chords of a Vertical Circle" and the pretty problems connected with it In the statics there is no mention of the stability or instability of equilibrium of one curved surface rolling on another The micrometer screw surprises us by appearing with the mechanical powers alongside of the wheel and axle and differential screw.

As the compiler has not acknowledged his indebtedness to other works, it is difficult to say how much of this book is original. But we seem to catch echoes of Ganot's "Physics" and of Goodeve's two text-books on Mechanics and Mechanism here and there. For instance, Articles 7, 8, 107, 111 remind one of Ganot, Articles 197, 207, 209, 239 of Goodeve The woodcuts, some of which are good, and others (*e g* those in the chapter on Centre of Gravity) very indifferent, are 190 in number Some of them are apparently reproductions of woodcuts in English books We instance Figs 44 and 175, which are strikingly like Figs 365 [Joule's apparatus] and 19 [block and tackle] in the eighth edition of Ganot's Physics, translated by Atkinson, and Figs. 142*a*, 150, 152, 155 (in Dana), which bear a very close resemblance to Figs 49, 58, 110, 113 respectively in Goodeve's "Principles of Mechanics," second edition, Fig. 117 in the latter having apparently supplied Dana's three figures, 162, 163, 164 [on Pulleys] Fig 145 in Goodeve's "Elements of Mechanism," fifth edition, may well have been the original of Dana's Fig. 156.

It would have been graceful in the compiler of this work to have expressed his acknowledgments to the two excellent little text books of Goodeve On the whole, with the reserve above made in favour of the "examples," we think that neither English teachers nor English students will be the losers if they continue to use already existing English text-books of Mechanics, and leave this American competitor to find an audience on the other side of the water.

CONSCIOUS MATTER

Conscious Matter; or, The Physical and the Psychical Universally in Causal Connection. By Stewart Duncan (London. David Bogue, 1881.)

AS the title of this little work sufficiently indicates, the aim of its writer is to furnish a scientific basis for the theory of materialism in the region of mind. It is doubtful whether at this time of day anything very original can be said upon this topic, but Mr Duncan has succeeded in placing some of the facts in a stronger light than previous writers The facts to which we allude are those which he calls the "analogies" between forces and feelings. Up to a certain point it is by every one recognised that there is some quantitative relation between neurosis and psychosis, mental processes are universally known to entail wear and tear of cerebral substance Mr Stewart Duncan traces this quantitative relation as much into detail as he can, by setting forth in a series of twelve "analogies" the resemblances between forces and feelings These "analogies" are far from being unopen to criticism severally, but here we shall merely mention what they are, as there is more important criticism to apply to them collectively The analogies are that feeling and force are each without extension, both related to matter, have "plurality predicable of them as respects their locality," are diverse, have time-extension or duration, also the quality of degree and capability of being compounded or combined, are respectively transmutable *inter se*, &c Doubtless, as Mr Duncan observes, such analogies, or, as we should prefer to call them, parallelisms, might be largely multiplied, but what would any number of such parallelisms prove? Not, surely, what Mr Duncan desires them to prove, viz that forces stand to feelings in the relation of causes to effects. So far as the tracing of such mere parallelisms is concerned, we might almost as reasonably conclude the recent earthquake at Chio to have been the cause of this review, in that they each possess extension, have diverse parts, and so on In order to establish a relation of causality we should require to show that the observed parallelism is due to that relation, we cannot argue from the observed parallelism as itself sufficient proof of such relation Were this not so, there would be no need for Mr Duncan or any one else to write a book on "The Physical and Psychical Universally in Causal Connection", for as the fact of a constant parallelism between neural processes and mental processes is now no longer an open question, were mere parallelism sufficient to establish proof of causality, materialism would now be a demonstrated theory

It is needless here to go into the whole question as to the relation of body and mind, or to point out all the shortcomings of materialism as a philosophical theory But it is a defect in Mr Duncan's work that he does not attempt to meet some of the most formidable of the difficulties with which this theory is beset Thus he does not consider the fact that what we know as matter and force we know only as affections of mind, and therefore that in all speculations upon the nature and potentialities of the former, we already by implication have necessarily assumed priority of the latter Nor does he seek to explain the apparent want of equivalency between supposed physical antecedents and supposed mental consequents—why it is that the brain of a Newton required less nourishment than that of an elephant Lastly, the greatest of all the difficulties is not adequately treated—that, namely, which is connected with the doctrine of the conservation of energy Are we or are we not to suppose that thought has a mechanical equivalent? If materialists say that we are, then thought itself becomes a mode of

energy, or rather energy by becoming thought ceases to be energy—is destroyed as energy, and so this answer would militate against the doctrine in question. If, on the other hand, it is said that thought has no mechanical equivalent, and yet that energy causes thought, the statement is still in conflict with the doctrine of conservation, because it supposes that energy in the brain differs from energy everywhere else in producing more than its equivalent measure of result. How then under any view are we to conceive of thought as an *effect* of energy? By no stretch of imagination can we attain to the idea of a motor becoming a motive; and if we could attain to such an idea, it would seem to be at the cost of upsetting the most fundamental doctrine of modern physics. And let it be observed in this connection that Mr. Duncan is not very accurate in the statement of his first "analogy," where he says that "Feeling and Force are alike in being both destitute of space-extension." Force in activity is only known as motion in space, while Feeling in activity cannot be conceived as here or there; the conception of Force without any actual or potential relation to space is as impossible as the conception of Feeling in such a relation.

Mr. Duncan's book, however, is worthy of the attention of psychologists, because although we think his attempt to prove a causal relation between physics and psychics a necessary failure, his work is interesting and suggestive if viewed from the standpoint of Clifford's doctrine of "Mind-stuff." If we suppose that Force and Feeling are everywhere one, and so that "all the universe is made up of Mind-stuff," we have a logically possible theory which does not labour under any of the logical disadvantages attending the theory of causality proceeding from matter in motion to mind, or *vice versâ*. Some passages in Mr. Duncan's work seem to show that he has very nearly entered this conception himself, and we therefore feel that he would have written a more valuable treatise if, going a little further, he had discarded the obsolete attempt to explain parallelisms by an impossible theory of *causality*, and undertaken to argue that these parallelisms are really due to a fundamental *identity*, which, as Lewes puts it, is phenomenally diverse only in relation to our modes of apprehension.

GEORGE J. ROMANES

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Study of the Physical Nature of the Sun

HAVING been engaged for some time past in discussing with that able scientist, the Spanish Astronomer-Royal, Signor Antonio Aguilar, Director-General of both the Astronomical and Meteorological Observatories of Madrid, the best method of realising for the requirements of modern science the peculiar advantages presented by the Peak of Teneriffe for studying and eliminating the interfering effects of the earth's atmosphere on many classes of astronomical, meteorological, and physical observations—it has just resulted, not exactly in the general facilitation which I had hoped for towards the *savants* of all nations—but in a particular letter to myself of gracious recommendation by Spanish royal authority to the Captain-General of the Canarian Archipelago.

As however I am totally unable, for reasons well known to our own Government both now and for many years past, to undertake any such research, however useful or pressing—it may be of service to the cause, and to other workers who are more favourably situated financially, to make known how liberally the Spanish Government is inclined at the present moment towards any genuine efforts, even of individuals, to improve our knowledge of the great central luminary by making superior observations with improved instruments at some considerable level above the ordinary clouds and winds of the summer season; and which superiority of site can only be well obtained on this side of the world by means of that grand Mountain-island which Spain has ruled so long and so well,—viz. the Island of Teneriffe. I have therefore now the pleasure of appending a close translation of the official letter, or rather Royal Order, from Madrid,—a copy of which Don Antonio Aguilar kindly informs me has already been communicated by the Spanish Government to the Chief Governor of the Canarian Islands.

"*From the Ministry 'de Fomento,' Madrid, to the Director-General of Public Instruction.*

"ILLUSTRIOUS SIR,—In consequence of the Report of the Director General of the Astronomical and Meteorological Observatories of this capital, the King has deigned to order that the Governor of the Province of the Canaries, and all authorities dependent upon him, should give special attention to provide whatever assistance he may require to Mr. Piazzi Smyth, Director of the Observatory, Edinburgh, in the expedition which is proposed to the Island of Teneriffe, with the object of trying, on the height of the Peak of Teyde, the instruments designed, or improved by him for the study of the physical constitution of the Sun.

"By Royal Order I transmit this to you for your information, and may God preserve you many years.

"(Signed) — — —

"On the 22nd March, 1881."

A friend well acquainted with both England and Spain informs me that we have not in this country any exact analogue to the Ministry "de Fomento." The literary or theoretical meaning of the word is "supporting, encouraging, cherishing", and the practical result in this case has been, that a poor individual here, unrecommended by the Government, or the greater Learned Societies, or Universities of his own land, but having an *excelsior* natural object to labour at, has received this very honourable testimony and encouraging recommendation. All honour then to the Government of Spain therefor, and may they meet at last with a more worthy subject for their gracious "Fomento," than Your obedient servant,

Edinburgh, April 9 PIAZZI SMYTH

Winter Gnats (Trichocera)

THE winter gnat (*Trichocera hiemalis*, D. G.) is one of the subjects of phenological observations undertaken by the Meteorological Society. Its appearance directly after long-continued frost, often whilst the thaw is in progress, has frequently led entomologists to inquire whether the insects then seen have been hybernating during the cold weather, or have newly emerged from the pupa. No evidence has been adduced in support of either alternative. Some facts concerning the habits of the fly, noted as opportunity occurred during the last two winters, bear upon the matter in question, and may therefore be of interest to both the above classes of your readers. The name *Trichocera hiemalis* is used here in its meteorological sense, for nobody would pretend to distinguish this abundant species at a distance from the common *T. regelationis*.

With a view to learning what becomes of the winter gnats during inclement weather I frequently jotted down, when the flies were upon the wing, the temperature of the air in the places of their resort, the time of the day, and any peculiarity noticeable in the flight of the insects. Upon other occasions, at corresponding periods of the day, when the weather was colder and no gnats could be seen anywhere, I made similar entries of the temperature prevailing in their usual playgrounds. The instrument employed was a Casella's pocket-thermometer mounted in ebonite, graduated upon the stem at intervals of every two degrees, and duly compared with a standard.

From the notes thus obtained, which need not be quoted in detail, it appears that the flight of *Trichocera* varies in style with the temperature, and, as a general rule, is altogether discontinued when the cold exceeds 36° F. Once indeed I saw a gnat flying when the thermometer stood at 34°.5 F., but there was reason for suspecting that it had just been startled out of the hedge by a passing carriage. When such low readings as these are obtained the insects do not congregate, but fly singly with a heavy drowsy flight, as though impelled by business rather than pleasure, and very few venture to show themselves upon the wing at all. At temperatures of 38° to 42° F. they may be seen occasionally flying steadily in places sheltered from wind, and when a warmth of 45° F., or more, is attained, they throng together and dance for joy. These particulars, by the way, need not prompt meteorologists to do something with their phenological tables by entering in them "*Trichocera* flying" every calm winter's afternoon if the temperature exceeds 40° F., without troubling themselves to go out of doors and look after the gnats.

It was some time before I succeeded in tracing *Trichocera* to the places where it seeks repose after its gambols and whiles away periods of weather too cold or boisterous for excursions abroad. The flies may be seen sometimes at rest upon fences, with their legs stretched out flat, and it appeared probable that they took refuge in the hedges somewhere. A very favourite harbourage of theirs however seems to be the under side of boards and stones frequented by woodlice and earthworms. They stand back downwards on the wood or stone, not upon the earth below, and although the specimens found in such situations are mostly females who have gone there to lay eggs, I have once or twice noticed males taking shelter in similar places. Beneath a single flower-pot saucer standing upon damp earth, and eight inches across the bottom, I have counted as many as ten females at once; an individual gnat dislodged crept back underneath it again; but the site became dry, and they forsook it. The wonder was how they managed to enter so shallow a crevice in the first instance. The haunts of the isopod, *Trichoniscus pusillus*, are not too damp for them; but in frosty weather they are apt to take shelter under any dry pieces of wood lying loosely upon the ground. It is obvious that flies with such habits as these cannot fail to be snowed up in great numbers at the first fall; and when the frost is over, having been securely protected from extreme cold, they are ready to take wing again as soon as the snow has melted sufficiently to admit of their creeping forth. Hence, though the temperature may be relatively mild directly after a snowstorm, no gnats are likely to be seen flying until the snow has largely disappeared, when *Trichocera* will become common. Similarly after frost without snow, when the thaw sets in the flies will probably not issue from their retirement immediately, but will rest quietly until the change of temperature has had time to reach them in their lurking-places, whatever may be the warmth of the outer air meanwhile. Perhaps this is the cause of so few winter gnats being seen in the mornings early in the year; but whether it be so or not, the other foregoing surmises harmonise well with my observations.

The maximum of cold to which winter gnats can be exposed without fatal consequences has not yet been ascertained.

Chepstow Road, Croydon, April A. E. EATON

Australian Plants in India

IN NATURE, vol. xxiii. p. 370, some remarks are made (with reference to Mr. Wallace's observations in "Island Life") regarding the apparent inability of Australian plants to become naturalised in the northern hemisphere. It may therefore be interesting to you and to Mr. Wallace to learn of some striking exceptions to this rule in the case of Australian plants which have been introduced on the Nilgiri plateau in Southern India, at elevations ranging from about 5500 to nearly 8000 feet above sea-level. Acacias and Eucalypti in particular have found a congenial home in this region, and visitors from Australia who have seen them say that they appear even more vigorous than in their native soil. Hundreds of acres of *Eucalyptus Globulus* and of *Acacia melanoxylon* and *A. dealbata* have been planted by Government as firewood reserves, and the trees have grown up splendidly. The only drawback to the success of the experiment has been that the *Acacia melanoxylon* has been greatly injured by Loranthaceous parasites. In fact this species will apparently in course of time be exterminated by these indigenous pests. Besides *Eucalyptus Globulus* the following species of the genus have also been introduced, and thrive well:—*E. sideroxylon, E. obliqua, E. fissilis, E. rostrata, E. viminalis, E. amygdalina,* and *E. perfoliata*. In addition to the two species of *Acacia* already mentioned, the following have also been added to the list of healthy growing exotics on the Nilgiris, viz. *A. pycnantha, A. salicina, A. longifolia, A. decurrens, A. cultriformis, A. elata*, and others might also be enumerated. As regards other Australian plants on these hills we have *Hakea, Banksia, Myoporum, Kunzea, Tristania, Pittosporum, Beaufortia*, &c. In short there is a very considerable Australian flora flourishing on the "Blue Mountains" of Madras, and so extensively have the trees been planted out about the principal stations that they have given quite a new character to the scenery. Some of the acacias have a considerable resemblance in shape and colour to the Scotch fir, and this likeness has, to some visitors, added a fresh charm to the beauties of the scenery. G. BIDIE

Madras, March 15

The Tide Predicter

WITH regard to the letter of Sir William Thomson in NATURE, vol. xxiii. p. 482, respecting the above instrument, I may say that the Tide Predicter which I have planned and designed for the prediction of Indian tides owes its development, not to the British Association Tide Predicter, but to a complete two-component working model made by me in the spring of 1873. This model was made before the British Association instrument was designed.

It was on the express recommendation of the Surveyor-General and Superintendent of the Great Trigonometrical Survey of India that I was invited to plan and undertake the construction of the instrument, and I was left absolutely unfettered in my choice of mechanicians to carry out the work. My connection with the instrument is clearly explained in the official prefaces to the Tide Tables for Indian Ports, 1881, published by authority of the Secretary of State for India in Council. I may point out that my paper upon this instrument (*Proceedings* Roy. Soc., No. 197, 1879) was written at the desire of Sir William Thomson, to whom it was first submitted, and by whom it was entirely approved and originally communicated. He was also present at the meeting of the Royal Society when the paper was read, and never expressed the least objection to any of its contents. In that paper credit is given to him for the improved slide, which he, with Prof. James Thomson's assistance, had devised for an harmonic analyser, and also to Mr. A. Légé for the admirable plan of the wheel gearing. EDWARD ROBERTS

3, Verulam Buildings, Gray's Inn, W.C., March 26

"The Oldest Picture in the World"

IN Mr. Loftie's "Ride in Egypt" is a woodcut (p. 209) of what is called "the oldest picture in the world," a fresco from a tomb at Maydoom, now in the museum at Boolak, wherein are represented six "pasturing geese." Two of these are undoubtedly *Anser albifrons*, two, probably *A. ferus* or *A. segetum*, and the other two seem to be the rare *A. ruficollis*, from Northern Asia. I should be greatly obliged to any one who would let me see a *coloured* copy of this picture, that I might be assured as to my determination of the figures. Mr. Dresser, in his excellent "Birds of Europe," mentions his having received a specimen of *A. ruficollis* sent him from Alexandria by the late Mr. Stafford Allen. Otherwise its appearance in Egypt seems to have been hitherto unrecorded. ALFRED NEWTON

Magdalene College, Cambridge, April 10

Probably New Variable Star

ON January 22, 1879, I observed near O[2] Canis, a very remarkable double star, with one component a fiery red 8·5

magnitude, and the other a blue 9 The contrast of colours was very striking, but there was little difference in size In a letter recently received from the Rev. Mr. Webb, I find that it was previously observed by him, and it appears as one of his own discoveries in the second edition of "Celestial Objects," published in 1868 The red star is there classed as 6·5 mag, and the blue as 8 The two stars, therefore, appeared to differ very considerably in magnitude when seen by Mr Webb, while to me, eleven years subsequently, they seemed quite nearly equal Hence I conclude that the red is a variable, and I wish to call the attention of observers to it while it still remains in view By a rough measurement I make out its position for 1881 = α 7h 10m 44s, and δ – 23° 6′ 6 JOHN BIRMINGHAM

Millbrook, Tuam, April 9

Concealed Bridging Convolutions in a Human Brain

IN his work on the "Convolutions of the Human Brain" Ecker denies explicitly that the first and second external bridging convolutions of Gratiolet, as seen in Cercopithecus, Inuus, &c, are ever concealed, either in the higher apes or in fœtal or adult man I have however in my possession an adult human brain in which a convolution nearly corresponding in position to the external bridging one of Gratiolet is concealed, while another slightly external to it is nearly so The brain was hardened in nitric acid with the membranes on (a much preferable method, by the by, to that of first removing the membranes; as these, by absorbing the acid and swelling, serve, like so many wedges, to keep the convolutions apart, and prevent the shrinkage that otherwise takes place) There was no indication of any concealed convolution until the membranes, just moistened for the purpose with water, were being removed. Then, owing to the opening out of the sulcus occipitalis transversus of Ecker, the tip of one became visible, and this tip, even now that the edges of the sulcus are widely separated, is from one-eighth to one-sixth of an inch beneath the general surface

Its position relative to the great longitudinal fissure and to the posterior border of the gyrus supramarginalis seems to me pretty accurately to correspond to that of the external bridging convolution to those parts in the brain of an Indian pig-tailed baboon of undetermined species with which I have compared it, but in the latter the sulcus occipitalis transversus does not exist, while in this human brain, as is very common, the lateral or horizontal portion of the fissura parieto occipitalis, beneath the bevelled edge of which in the baboon the convolution lies concealed, has a very short course indeed

The only difference then is that in the one specimen (the human) the concealed convolution lies in the transverse occipital fissure, there being no lateral extension of the parieto occipital fissure, while in the other it lies in the parieto-occipital fissure, the transverse fissure not existing WILLIAM CARTER

Liverpool, March 26

Sound of the Aurora

IF I had consulted Franklin's account of his Polar researches before I sent you my extract from Tacitus, I should not have revived the question of sounds being heard with the aurora borealis. Franklin and his companions watched the aurora 343 times in two successive winter seasons, and never once, he says, did they observe a sound. Were, then, the experiences quoted by your other correspondent and myself mere illusions? Perhaps not Franklin made his observations at and about the southern shore of Bear Lake, in latitudes varying from 67° to 69° north, might not the greater volume of air through which the phenomenon had to pass in reaching our island have caused the electric fluid to work up a sound? Surely that is possible The attractive force of the aurora is—we learn from Franklin himself—increased within a certain limit as its rays proceed southwards, for whereas Parry and his party at Port Bowen in latitude 73° 15′ noticed no deflection of the compass-needle under the influence of coruscations, Franklin and his party on the shores of the Bear Lake, six degrees further south, constantly observed this effect And the attractive force is strongly felt here—hindering telegraphic communication at all events Might not the vibratory force not sensible at within so short a distance from its origin as the attraction be increased within a greater limit? M. L. ROUSE

Sunnymead, Chislehurst Common

PERIODIC OSCILLATIONS OF BAROMETRIC PRESSURE

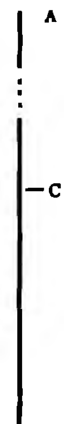
THE MSS of the accompanying article, which was left unfinished by the late Mr John Allan Broun, F.R S, were handed over to me some time ago by Prof Balfour Stewart, with a request that I would put them into shape for publication

I have not found it necessary to make many alterations in, or additions to the original, and where made they are mostly indicated in initialed foot-notes

E. DOUGLAS ARCHIBALD

In an article which appeared in NATURE (vol xix. p 6) a remarkable relation was shown to exist between the annual ranges of the atmospheric pressure and of the temperature of the air, as derived from the monthly means obtained from several years' observations of the barometer and thermometer at certain stations in India The results and the conclusions from them do not appear to have been always understood, and as they bear on some of the most interesting questions on meteorology, I shall now examine them anew with the aid of observations at some other stations, under different local conditions

For this end it is desirable to employ some elementary considerations Let us, first of all, consider the action of varying temperature on a vertical column of the atmosphere. Let us consider a column of air reaching from the soil at B to the upper limit of the atmosphere at A, and suppose that the pressure shown by a barometer at B is 30 inches, while at a higher station, C, it is only 20 inches If, now, the column of air is heated so that the temperature of the part B C is increased by 10° F. we know from laboratory experiments that the air will expand, so that a part of that which was below C will be pushed above it, and while the barometer at B will continue to show 30 inches, that at C will show 20 2 inches, the mercury at C will have risen two-tenths of an inch



If, now, we suppose that the mass of air remains constant throughout the year, there will be an annual variation of the barometer at C, where its height will be greatest in the warmest month and lowest in the coldest month For the same reason the difference of the barometric heights at B and C will be least in the warmest month and greatest in the coldest

It has been supposed that the mass of the atmosphere remains constant throughout the year, if this is not the case the variations of pressure at C will not depend on temperature alone, but also on the other causes which produce variations at B

In NATURE, vol xx p 55, Mr Douglas Archibald has given a series of differences of barometric heights at high and low stations in India for the months from October to April The month of lowest mean temperature, January, shows always, as in the case just supposed, the greatest difference of pressures As the high and low station is never in the same vertical, the one being sometimes 300 miles horizontally distant from the other, it is difficult to eliminate the part of the variation due to temperature at the higher station, but if we take as an approximation, however rude, the mean of the temperatures at the two stations as that of the vertical column, we can see that a considerable part of the variation at the upper station may be due to the expansion of the column with temperature

Thus for Leh and Lahore the mean temperatures and difference of barometric heights are [1]:—

[1] The numbers are taken from the work cited by Mr. Archibald, "The Indian Meteorologist's Vade Mecum," by Mr. H. F. Blanford, Pt ii pp 176, 178

	Mean temp	Diff of Pressures
	°	in
January .	35·0 Fahr	9 690
July	74 1 ,,	9·105

Now as the difference of the mean temperature of these two months is nearly 40°, according to what has been said before, the expansion of the air from January to July should have increased the pressure at the upper station by about 0·8 inch (eight-tenths of an inch of mercury) and have diminished the difference of pressures by that amount. The observed diminution is, however, less than 0 6 inch, a deficiency of two-tenths, which has to be accounted for in some other way

In the case of the annual variation of atmospheric pressure near the sea-level, we have to consider only the atmosphere above the station; but in that for a high station we have a much more complicated problem in which the atmosphere below the station plays an important part, a part also which may vary greatly, according as the upper station is on a mountain top, on a gradually ascending height, or on high table land

It was for these reasons that in the article (NATURE, vol xix, p 6) under consideration, nothing was said of the annual variation on mountains or at great heights, the results were obtained from observations at stations little above the sea level, and from them it appeared that for every degree Fahrenheit on the range of monthly mean temperature, there was a variation of from 021 inch at Singapore, to 025 inch at Bombay and Madras, in the range of the monthly mean barometric height, while at Pekin the amount was diminished to ·015 inch The conclusion that this ratio was nearly constant in India referred necessarily to stations under similar conditions. Mr. Archibald's letter has brought to notice a series of Indian observations made at stations farther from the sea and in North India, which are given in an interesting and useful work by Mr H F Blanford, Meteorological Reporter to the Government of India, and which merit consideration The means employed by me previously were derived from observations at standard observatories during five to twenty-six years, and it was mentioned that, as single years gave somewhat variable results, the monthly means from several years' observations were necessary for accurate values In the cases to be found in Mr. Blanford's work, several are of observations during only two years (or even less), and we have no exact idea of the weight which in any case can be accorded to the observations at the stations As, however, the results for different stations in general confirm each other (the exceptional cases will be noticed apart), I shall here form a series of groups of stations, each group under nearly the same local conditions as regards latitude, height above, and distance from, the sea The value of k, the variation in thousandths of an inch, of pressure-range for 1° F of the temperature-range, is the same for all stations in each group, with the exceptions referred to below

Thus the most northerly group near latitude 30° N and 600 miles from the sea, viz, Lahore, Delhi, Dera Ismail Khan, Mooltan, and Roorkee, gives the following result .—

Mean latitude of group (λ)	Mean height above the sea (h)	Mean annual temperature (t)	Mean ranges of temperature and pressure: Δt	Mean ranges of temperature and pressure: Δp	Mean barometric oscillation for 1° Fahr $\left(k = \frac{\Delta p}{\Delta t}\right)$.
°	feet.	°	°	inch	
30¼	660	75·2	39·0	0·620	0 016

This group extends about 450 miles from Delhi to Dera Ismail Khan, and the heights vary from 440 to 890 feet. The value of k is the same for each station.

The next group comprises Bareilly, Lucknow, Jhansi, and Benares, for which the following are the values of the different elements —

λ	h	t	Δt	Δp	k
°	feet	°	°	in	
26	520	77 7	32 4	0 554	0 017

The distance of the extreme stations is not 300 miles; the heights vary from 270 feet at Benares to 860 feet at Jhansi For each station k = 0·017.[1]

The third group includes Patua and Gya, and the values are—

λ	h	t	Δt	Δp	k
°	feet			in	
25½	260	78 5	28 0	0 537	0·019

The distance between the two stations is about 70 miles; the heights are 179 and 347 feet respectively, and the values of k are within half a thousandth of each other.

The fourth group includes Berhampore, Burdwan, Dacca, Goalpara, Chittagong, Calcutta, and Saugor Island, for which the values are—

λ	h	t	Δt	Δp	k
°	feet			in	
23½	100	78 0	18·7	0 471	0 025

With the exception of Goalpara and Chittagong, these stations all lie in the Gangetic delta, at nearly the same elevation, and with an extreme variation in the value of k amounting to 0 004 inch[2]

The fifth group includes Bombay alone, the values for which are—

λ	h	t	Δt	Δp	k
	feet			in	
18½	37	78 8	11·6	0 287	0·024

The sixth, Madras, Negapatam, Trichinopoly, and Madura, with the values—

λ	h	t	Δt	Δp	k
	feet	°		in	
11½	190	81 7	11·1	0·243	0 021

The seventh, Colombo, with the values—

λ	h	t	Δt	Δp	k
	feet		°	in	
6½	42	81 3	3 6	0 069	0·019

It will be seen from this table that the value of k is a maximum (= 0 025) nearly under the tropic of Cancer, that it diminishes thence both north and south This diminution cannot, however, be attributed altogether at least to the latitude, since the value is nearly the same at Pekin and at Delhi.

The variation of the value in Northern India from the maximum near Calcutta has an apparent relation to the height above the sea and the distance from it,[3] as well as to the amount of the temperature oscillation, the value of k diminishing as the others increase We cannot, however, relate the value to any one of the other variables No doubt height above the sea may have some influence, as has already been shown, but here mountain stations have been avoided, and while in the Lahore group the heights vary from 420 feet (Mooltan) to 890 feet (Roorkee), the value of k remains constant.

It should be observed that the temperature ranges are those of the stratum of air a few feet above the soil, while the ranges of pressure include the whole atmosphere above each station We see that the value of k dimi-

[1] There appears to be some difference in the values of Δp as got by Mr Broun and those derived from my edition of the "Vade Mecum" for these two groups Thus from my edition (1877), the value of Δp for Group I is 0 614, and therefore k = 0 015, there are also slight differences in the value of k at each station In Group II k is 0 017 only for Bareilly and Lucknow, the value for Jhansi and Benares being 0 016 —F D A

[2] The figures for the fourth group have been supplied, and the fifth, sixth, and seventh groups have been added as the text seemed to imply their intended formation by the author —E D A.

[3] Mr Archibald has considered height not to be an element, and he cites in evidence Lucknow and Sibsagar very nearly at the same height, the former having k = 0 017 and the latter k = 0 028 (NATURE, vol xx, footnote p 54 The latter value, however, is a mistake, for at Sibsagar k = 0 018, very nearly as at Lucknow Mr Archibald's conclusion is that it is not height, but distance from the sea, as the stations are at widely different distances from the sea We should, owing to this error, be obliged to reverse the conclusion, and say it is not distance from the sea, but height, that is in question, but, in reality, Sibsagar though not so far from the sea, is still as far as Patua or Gya, with nearly the same value of k

[See my note on this point, NATURE, vol xxi p 131 —E D. A]

nishes as the range of the surface-temperature increases, and it is certain that the ranges of the temperature at all the stations as we ascend above *the soil*, will approach always nearer to each other the higher we go; so that if we knew in what way the relation between the oscillations is produced, and thence, in all probability, the part of the atmosphere which is chiefly in question, we might find a more constant relation between Δt and Δp at all the stations.

I will now proceed to make some remarks which may aid in the study of these questions I would first observe with relation to the stations in the preceding table that the value of k is only 0·024 at Chittagong, while it is nearly 0·029 at Saugor Island I have no doubt, however, that this difference is due to some local or instrumental cause

In the first article I have, as already stated, used only observations made in first-class observatories. Every one acquainted with the difficulties of obtaining good observations in India, especially at out-stations, will understand that the mere printing of their results cannot give them any certain weight Thus from the tables of means given in Mr Blanford's work, it appears that the value of k at Vizagapatam is 0·032, while at Cuttack less than 3° to the north, it is 0·025 This great difference would lead to the conclusion that there must be some remarkable local cause, or that there is some error in the observations, if the former, then farther research as to this cause would be of the highest importance; the latter seems to me the most probable explanation The following example, that of a station so well known as Madras, will show some reason for this belief. The results for Madras, given in the table, are those employed in the first article, and deduced from observations made in the Magnetic and Meteorological Observatory from 1841 till 1855 In Mr Blanford's tables, however, means are given from observations for nine years These means give results markedly different from the others. The following summary for the months of December, January, and June, will prove this —

Group of Years	Height of Barometer December	January	June
1841–45	29·954	29·998	29·691
1846–50	957	986	693
1851–55	992	998	702
Means	967	994	695
1868–71	978	967	671
1872–76	955	926	802
Mr. Blanford's means for nine years	965	·944	·744

Now the three means for January, each deduced from five years' observations, do not deviate from the mean of the whole more than 008 inch, while the corresponding extreme deviation for June is 0 7 inch Whereas the means from nine years, according to Mr. Blanford's tables, differ by 0·050 inch from the means of fifteen years, and the annual range, which is 0·299 by the fifteen years' observations, becomes only 0·200 by the last series Judging from the means for four years—given by Mr Blanford in his valuable memoir in the *Phil Trans.* on the winds of North India—which I believe to be part of the nine years, the means for five years, 1872–76, give a range of only 0·124 inch from January to June, but even the mean pressure for the place and the annual law of variation is altered by the nine-year series, the maximum pressure occurring in December instead of January. It is essential in such investigations that some confidence can be placed in the observations, and if this can be done anywhere it is certainly in observations made at such a station as Madras. I have employed previously means deduced from fifteen years' observations in the Magnetic and Meteorological Observatory, but these means differ in a manner so extraordinary (for a South Indian station) from the means given by Mr. Blanford from nine years' observations, that this demands attention and explanation [1]

We see that the annual oscillation of pressure increases with that of temperature, and as shown in the article already cited, that this relation holds for two places on opposite sides of the Ghâts, nearly at the same height within sixty miles of each other, for which the annual oscillations at one are twice those for the other.

Let us now see what our knowledge from laboratory experiments of the laws of expansion and equilibrium of gases would induce us to conclude with reference to the stations in question

In the first place, let us remember that the yearly mean temperature at Pallamcottah is about 7° Fahr greater than at Trevandrum, while the yearly mean pressure is the same We conclude at once from this result that the mean pressure does not depend on the mean temperature.

I stated that the mean temperature in January at Pallamcottah, on the east side of the Ghâts, was 4° Fahr. greater than at Trevandrum, sixty miles distant on the west side of the mountains, and that the mean pressure was 0·065 greater at the former than at the latter Sir John Herschel has shown that according to our knowledge of the expansion of gases, there should be a single diurnal atmospheric tide due to one side of the earth being warmer than the other, and this due to the expansion of the gases in the warmer half causing the centre of gravity of the air to be higher than in the other, should produce a sliding motion of the warmer air towards the colder in twelve hours.

If such a result is what may be supposed to occur in the period of a day, there cannot be the smallest doubt that if a mass of the atmosphere has a lower pressure and a lower temperature than another mass at a short distance, the former should flow towards the latter, and produce equilibrium within twenty-four hours Here, however, we find that there is a difference of pressure of 0·065 inch, which remains during a whole month at a distance of sixty miles, and this continued difference of pressures is not to be explained by any known property of gases

We see, indeed, the remarkable fact that the oscillation of the monthly mean pressure at one station proceeds quite independently of that at the other, and both in a constant ratio with the variation of the temperature of the atmosphere in the lowest stratum.[2] All this is inexplicable by any heating action alone

I have omitted all notice of the aqueous vapour in the atmosphere. It is obvious, however, that this cannot explain the annual oscillation of pressure, since it is just when the tension of vapour is greatest, that the barometric height is least The introduction of more vapour into the atmosphere does not make the whole lighter, but heavier, and when we adopt the arithmetical operation of Dove and subduct the vapour pressure from the barometric height, we find the oscillation to be greater, not less, than before

It is not easy to determine the variation of vapour pressure from the indications of the dry- and wet-bulb thermometers, and the exact result of the total vapour above the barometer cannot as yet be determined, but its amount will not explain the annual law, nor will it explain the independent oscillations in question. I have, however, long ago suggested that the humidity of the air may be in question, and as the oscillations of dryness or humidity of the lower mass are probably related to the temperature, the oscillations of pressure may also be related to them.

Sedgwick has said, in his inaugural discourse on the

[1] Mr Broun asked me if I knew what years made up the nine, but I know of no one except Mr Blanford himself who can give a satisfactory answer to this question, and he is in India. The "Vade Mecum" being an official work, ought certainly to be trustworthy.—E D. A

[2] And probably of the mean temperature of a layer of some considerable height.

studies of his University. "To explain difficulties in these questions, the atmospheric strata have been shuffled in accordance with laboratory experiments" Thus, for example, the mean pressure of the atmosphere remains, on the average of the whole year, 0·038 inch lower for every 100 miles we proceed north in this country, a difference which is called a *gradient*, as if it were a fall on a railway line, though it is really the position of equilibrium like that of the watery ocean, which has also a gradient of nearly thirty miles from the equator to the poles

I have previously remarked that at Bombay the maximum pressure precedes nearly by a month the minimum temperature, while the minimum pressure is a month later than the maximum temperature This is also true for all the stations in North India At Madras, however, and Trevandrum, January becomes the month of maximum pressure. I do not, therefore, place much weight on this fact as showing that the two oscillations are not cause and effect The month of maximum pressure at Pekin agrees most nearly with that of minimum temperature

I have stated in the first article on this subject that I did not admit that the oscillation of pressure was due to that of temperature, and therefore could not allow that a higher annual mean temperature [would in any case cause a lower annual mean pressure] From the fact that the annual variation of pressure and temperature in Central Asia is greater than in any other portion of the globe, the greatest pressure coinciding nearly with the lowest temperature, and the least pressure with the highest temperature, it was concluded by Mr Chambers that years of greatest mean pressure should also be years of least mean temperature Now if we assume that the pressure depends only on the mass of the air and watery vapour in it, as the former is constant, and the latter, the only variable part, is greatest when the temperature is highest, it would follow that years of greatest heat should be years of greatest pressure, which is just the reverse of the conclusion deduced by the analogy from the annual variations

Indeed, it is one of the great difficulties in the hypotheses which have been proposed, to explain the annual variation of pressure of the mixed atmosphere, that when we subduct the vapour pressure, as far as our means of calculating this exist, we have a much larger dry air oscillation than before

I gave, however, different reasons for concluding that the range of temperature was not itself the cause of the diminished pressure, although the two go nearly together One was that the observations of Bombay showed the greatest pressure to precede the lowest temperature by a month, and this is true for all the stations in the groups of North India already given I also pointed out that were the two directly related, the mean pressure at Trevandrum should be greater than at Pallamcottah by nearly one-tenth of an inch, which is not the case, the isobars and isotherms having no relation to each other

If we suppose that we have the same atmosphere over each station as over the whole earth, there is no possibility of explaining the variation of pressure by that of temperature. The only known property of heat which affects the mass has no doubt been employed to cause the hotter air to flow away somewhere, and surely in that case it should flow to the nearest colder station, where the pressure is less; but we have seen that this is not so in the case of Trevandrum and Pallamcottah, nor is it so in the valleys of the Ganges and Indus, where the oscillation increases as we ascend from the sea. These oscillations proceed with the greatest regularity, approximately in proportion to the temperature variation from month to month, and without the slightest regard to the hypothesis which should cause equilibrium in twenty-four hours, by the sliding of the most expanded masses over those least so. In what way, then, can we associate the two oscillations if one is not the cause of the other? I have long ago suggested that the varying humidity of the air may be in question, this is only a suggestion I do not mean the mere tension of vapour—as already stated when we try to get rid of that from the total atmospheric pressure, the subject becomes more difficult, the dry air oscillation being greater not less than that of the whole—but if we suppose that the attraction of gravity is not the only attraction which affects the pressure of the atmosphere, but that this pressure varies through some other attracting force such as an electric attraction of the sun depending upon the varying humidity of the air, and this again depending on its temperature, we should find a method of relating the two variations which does not exist if gravitation alone is employed

It is quite certain that many physicists will not admit the idea of an electric attraction on our atmosphere in the present state of our knowledge, hence the efforts to make expansion, and a shuffling of the atmospheric strata suffice We must not, however, in our ignorance, attempt to force conclusions in opposition to facts, and if these can be satisfied more easily and with greater probabilities in its favour by the aid of the hypothesis of an electric attraction of the sun, that hypothesis will have a better claim to acceptation than the other

I shall here note a few facts which cannot be explained by thermic actions

1 I have shown that on the average of many years' observation in our latitudes the mean pressure diminishes at the rate of 0 038 inch of mercury for every one hundred geographical miles we proceed towards the north. This has been called a gradient from the similar term used in railway slopes; but it is no slope, it is a level of a surface of equilibrium like that of the sea It is the mean heights of the barometer at the sea-level which indicate the form, if we may say so, of the equilibrating atmosphere

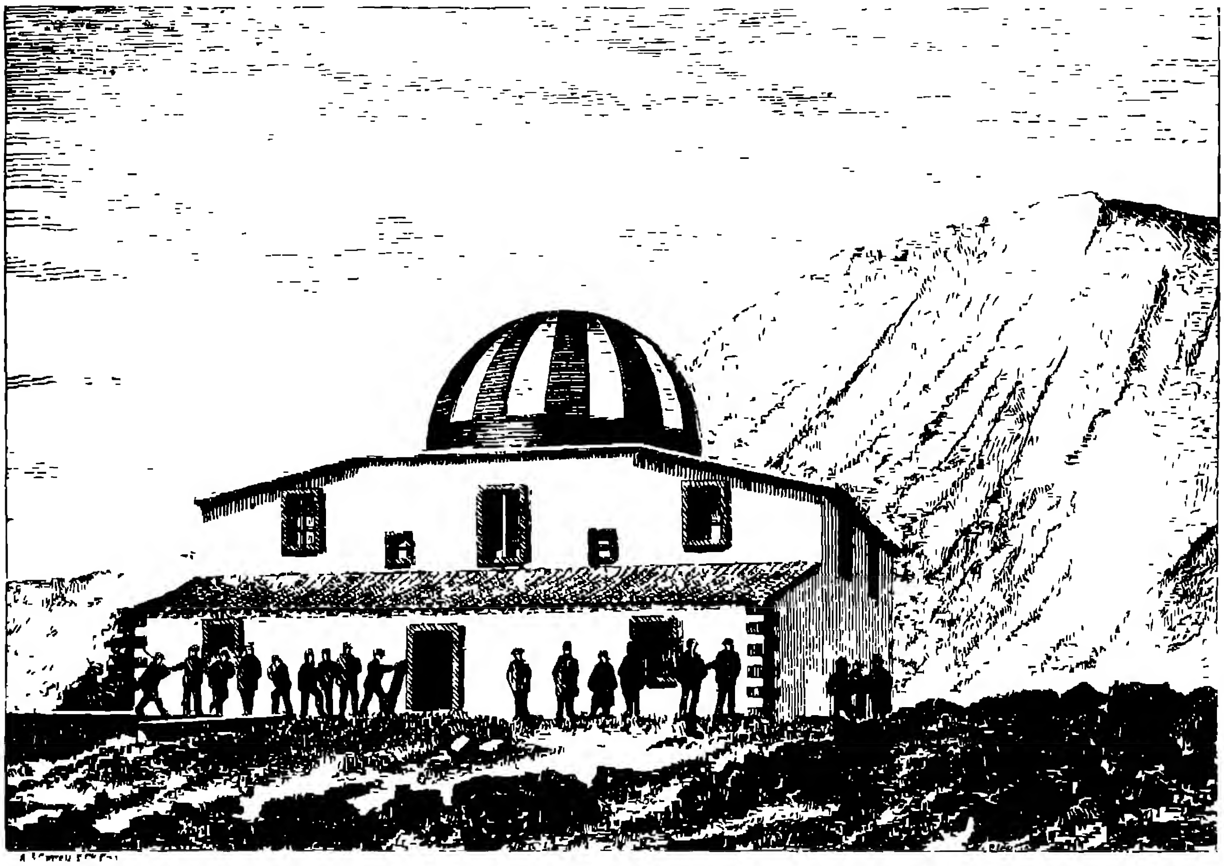
2 In India we have seen that the atmospheric pressure oscillates at each station even when these are quite near to each other, independently of the known laws of equilibrium of pressure of gases

When we turn to the semi-diurnal oscillation of the barometer we are only amused at the attempts made to explain it by shuffling the atmospheric strata Nothing can be more certain than that the theories of expansion, or resistance to expansion and overflow, are the vain efforts to make the laws of nature agree with a theory, Over the great ocean within the tropics, where the diurnal variations of temperature are small and the air is absolutely without perceptible currents for days together, the barometer rises and falls a tenth of an inch twice in twenty-four hours with the regularity of the solar clock The action of the sun on the whole atmosphere which produces this movement varies chiefly during the day hours at inland stations with the temperature oscillation, so that, as in the case of the annual variation, the fall of the barometer at 4 P M is greater in the same latitude as the temperature is higher This variation occurs during the most complete calms; the smoke rises vertically from the plains of Tinnevelly, no current is visible in the motion of the clouds, yet the barometer falls at four in the afternoon as it did at four in the morning, only it falls farther

THE ETNA OBSERVATORY

THE accompanying illustration of the Observatory on Mount Etna is reproduced from the *Memoirs* of the Italian Spectroscopic Society It shows that the building is so far complete, and surmounted by its revolving dome for the protection of the large Merz equatorial of thirty-five centimetres aperture. In the engraving the volcanic cone appears much nearer the Observatory than it really is. The work of building was suspended during the stormy weather of 1879, but was completed in the summer of last year But it cannot be said that the

building is yet quite finished and ready for occupation; a good deal of work has yet to be done to the internal walls, the doors and windows, flooring, &c., besides the scientific equipment of the building. Therefore the announcement by the Alpine Club of Catania that the building would be ready for inauguration at the meeting of the Alpine Congress in Catania next September was premature. The Observatory will not really be ready to be opened till 1882. The difficulties that have had to be contended with can only be comprehended by those



who have visited the place, all the materials have to be conveyed 3000 metres above the level of the sea, and that during only three months in the year. So that even if not ready till 1882, the work may be said to have been rapidly accomplished. The mounting of the equatorial is finished and the construction of the meteorological apparatus is being proceeded with. The Ministers of Agriculture and Public Instruction are doing their best to provide the Observatory, by 1882, with a director and a staff both of astronomers and meteorologists.

MODE OF MASKING OR CUTTING OFF SHARPLY THE LIGHT FROM REVOLVING APPARATUS ON ANY DESIRED COMPASS-BEARING BY MEANS OF A RECIPROCATING SCREEN

OWING to the optical properties of the lens employed in revolving lights, a formidable element of difficulty comes in the way of effecting a sharp cut-off on a particular bearing; for the direction of the axis of the beam of light which is projected by the lens is being continually changed in the horizontal plane by the revolution of the frame on which it is fixed. So long as the axis of this beam of rays points outside of the line of obscuration the light will not of course encroach on the danger arc, unless to a small extent, when the axis is nearly on the line of cut-off due to the ex-focal rays proceeding from the outer edges of the flame. The light however will begin to be diminished in power from a bearing varying from 12° to 21° outside of the line of cut-off dependent on the size of the lens, the light on the line of cut-off being diminished to the power of one-half. But when the axis crosses that line, then as the rays which come from that part of the apparatus which is still outside of the darkened panes of the lantern is not intercepted by them, the light will begin to be seen within the arc of danger, and as the apparatus goes on revolving the axis will at last point from about 12° to 21° within the danger-arc, according to the breadth of the lens which is employed. Owing to this peculiarity of a revolving light the difficulty of confining the flashes within any required arc of the horizon by means of *fixed* screens is in fact an insurmountable one.

The mode which I have to suggest is as follows:—In front of the revolving apparatus and on the safety side of the danger arc, let a light canvas or metallic screen be constructed for running on rollers on a slightly inclined rail or circular path close to the apparatus. If now a small projecting rod or snug be fixed to the side of each lens it will in revolving be brought against the edge of the screen, and will gradually press the screen before it up the inclined plane at the same rate of motion backwards

as that of the lens forwards. By the time the lens reaches the edge of the danger-arc the screen will have been pushed to the top of the inclined plane, and the full beam of light coming from the now entirely uncovered lens will be pointing in the required line of cut-off which is the border of the danger-arc But whenever the further revolution of the apparatus causes the snug to pass clear of the edge of the screen so as to free it from pressure, it will immediately run back again to its original position in front of the lens, so as to prevent any light being now sent forwards If that light were not at once intercepted part of it would, by the movement of the frame, begin to pass across the line of cut-off, so as to be seen within the danger-arc. By this continued reciprocative movement of the screen as lens after lens comes round, the same effect will be successively produced, and the light will always be cut off in the line of obscuration as sharply as in the case of a fixed light, so that the flashes will never be seen within the danger-arc.

In cases where the light has to be cut off on both sides of a danger-arc a similar reciprocating screen is as applicable to the lenses when passing out as when passing into the danger-arc But in this case the lens, on leaving the danger-arc, will take the screen round with it up an inclined plane until the axis of the lens is parallel to the line of cut-off, when the screen will recoil and the light become visible with full power in the line of cut-off

A small spherical mask placed inside of the apparatus may be made to produce the same effect by reciprocating between the lenses and the flame. When the danger-arc is of small amplitude the screens, which must always be as broad as the lens, might come in the way of the light passing over the safety-arcs. To obviate this, cloth curtains might be made to wind up on vertical rollers similar in construction to those used for ordinary house-blinds

THOMAS STEVENSON

CHLOROPHYLL[1]

AN account was given in NATURE, vol. xxi, p 85, of Prof. Pringsheim's first publication on this subject. He had then found that exposure to intense light for a few minutes causes the chlorophyll-corpuscles contained in the cells of plants to lose their green colour, he also pointed out that this effect is produced not by heat but by light, and only in the presence of oxygen, and further, that the highly refrangible rays of the spectrum are those which are principally concerned in it He also announced the discovery in the chlorophyll-corpuscles of a substance termed Hypochlorin

The paper now under consideration gives a full account of all the observations and experiments which he has made up to the present time, and he considers that they tend to confirm the conclusions at which he had previously arrived. It will be well, before entering upon a discussion of the very difficult questions which are raised, briefly to enumerate the principal new facts which he now brings forward.

In the first place, he is able to throw some light upon the intimate structure of chlorophyll-corpuscles by means of a new method for investigating them. This method consists in treating them with a dilute acid (*e.g.* 1 vol. of glacial acetic acid to 2 of water, or 1 vol. of picric acid to 3-6 of water, or 1 vol. of sulphuric acid to 20-40 of water, or 1 vol. of strong hydrochloric acid to 4 of water), or warming them in water, or exposing them to the action of steam. The effect of this treatment is to cause the escape of the chlorophyll from the corpuscle, together with certain fluid or semi-fluid substances which accompany it, in the form of viscid drops, leaving the ground-substance of the corpuscle as a colourless, apparently protoplasmic, hollow sphere, with a much perforated wall.

[1] "Untersuchungen über Lichtwirkung und Chlorophyllfunction in der Pflanze," by Prof. N. Pringsheim (*Jahrbücher für Wiss Bot*, Bd XII, Heft 3 Leipzig, 1881)

These viscid green drops, when produced by the action of warm water or of steam, appear to consist of an oil which holds the chlorophyll and other substances in solution. When they are produced by means of a dilute acid, they appear to contain a substance which is not present when they are extracted by warm water or by steam. Certain dark brown masses make their appearance which are of a tolerably firm consistence and of varying form. These gradually become harder, and assume a crystalloidal appearance, probably, as Prof Pringsheim suggests, in consequence of a conversion into resin of the oily matter which is present; but it is by no means the whole of the substance which thus solidifies, but only a certain constituent of it The colour of the mass is doubtless due to the presence of altered chlorophyll, and this may affect even the crystalloids, but they may be obtained colourless. It is to the substance which assumes the crystalloidal form, or rather to some substance pre-existent in the chlorophyll-corpuscle from which these crystalloids are derived by the action of the acid, that Prof Pringsheim gives the name of Hypochlorin

He meets the doubts that may arise as to the chemical individuality of this substance, as also the suggestion that it may be a product of the alteration of the chlorophyll, by pointing out that it cannot usually be obtained at any one time from all the corpuscles of a given cell It is therefore a substance which, as it is present in some and not in others, cannot be derived from chlorophyll which is present in them all, and which probably bears some definite relation to the metabolic processes going on in the corpuscles

Since no hypochlorin can be obtained from cells which have been warmed in water or acted upon by steam, it appears that this substance is decomposed by heat.

After giving a detailed description of the arrangement of the apparatus used in his observations, Prof. Pringsheim goes on to give an account of the effects produced by exposure to intense light in the different parts of which the cell consists. He again insists that none of the following phenomena can be the results of excessive heating of the object, for he found that cells not containing chlorophyll (*e.g* colourless zoospores) could bear the exposure for half-an-hour without injury, and further, that the phenomena were produced more readily by blue or green light than by red light which has a much greater heating effect The principal phenomena observed are as follows —

1 The colouring-matter

The chlorophyll-corpuscles lose their colour in a few minutes, but this does not take place when oxygen is not present, nor in red light There is no trace of chlorophyll left in the corpuscles. Prof. Pringsheim is therefore of opinion that its decolorisation is a phenomenon of oxidation, and that the products are gases. Further, this disappearance of the chlorophyll is not prevented by the absence of carbonic acid gas. The corpuscles which have lost their green colour do not regain it, although the cell in which they are contained, still continues to live, on this account Prof Pringsheim regards the decomposition of chlorophyll as a pathological and not as a normal process

Colouring matters, other than chlorophyll, which occur in the cells of plants, are likewise decomposed, but not all of them. Thus, the blue pigment of the Phycochromaceæ, the brown of Fucus, the red of the Florideæ, the orange of the corolla of Calendula, the blue in the cells of the staminal hairs of *Tradescantia virginica*, disappear, but the blue pigment in various flowers is not decomposed by exposure to intense light

2 The ground-substance of the chlorophyll-corpuscles and their contents

If a cell of Nitella or of Spirogyra be killed by the action of heat, for instance, the chlorophyll-corpuscles of the one and the spiral band of the other will absorb water

and swell up If the cell has been killed by prolonged exposure to light, no such absorption of water will take place.

Prof Pringsheim mentions starch, oil, and tannin as commonly occurring in the chlorophyll-corpuscles[1]; these substances, which contain a considerable proportion of oxygen in their molecule, are not affected by the action of light

3 Hypochlorin

No trace of this substance can be detected in cells which have been exposed

4 The protoplasm of the cell

The turgidity of exposed cells is lost, the protoplasm readily allows colouring matters to pass through it, and treatment with plasmolytic reagents produces no contraction In a long cell, part of which has been exposed to the action of light, it is only the portion of the protoplasm which has been exposed that exhibits these alterations in its properties Moreover, these changes are apparently accompanied by a perceptible loss of substance

A brief exposure causes an arrest of the rotatory movements of the protoplasm in cells which exhibit it If the exposure has not been prolonged, these movements will recommence after a time If a portion only of such a cell be exposed for not too long a time, the movements will be arrested in the exposed portion, whereas it continues in the rest of the cell.

5. The cell-wall

The only effect which the exposure produced on cell-walls appears to have been that the cells of the more delicate filaments of species of Spirogyra and Mesocarpus become isolated

The following are the general conclusions which Prof Pringsheim draws from the facts which have been stated above He concludes that the injurious effects produced by the exposure of a cell to intense light in an atmosphere containing oxygen, are due to an increased oxidation of certain substances which are essential to its life The rays which are active in this process are not those which reach the interior of the cell after having passed through the chlorophyll-corpuscles, but those which reach it directly He finds, it is true, the cells which do not contain chlorophyll are, on the whole, less sensitive to the action of light than those which do contain it, but there are no grounds for believing that this greater sensitiveness is due to the absorption of any light-rays by the chlorophyll. On the contrary, the presence of chlorophyll in a cell seems rather to diminish than to increase the oxidising action of light Facts are adduced to show that chlorophyll exercises a protective influence in this respect, and it is further pointed out that the death of the cell, when exposed to intense light, takes place *before* the complete decolorisation of the chlorophyll-corpuscles has been effected The greater sensitiveness to the action of light of a cell containing chlorophyll is ascribed to the presence in it of the readily-oxidisable products of its assimilatory activity, and of these hypochlorin is the most important

Prof. Pringsheim's theory of the function of chlorophyll is, then, (1) that the respiration of a cell is increased by exposure to light, (2) that, in consequence of the absorption which takes place when light passes through chlorophyll, the presence of chlorophyll in a cell tends to counteract the influence of light, so that, when the light is not intense, the respiration of the cell is so far diminished that processes of reduction can take place within it, but when the light is very intense the chlorophyll itself undergoes decomposition, and the death of the cell is brought about by the excessive oxidation of certain of its essential constituents.

[1] He quotes the observations of Briosi to prove that oil, and not starch, is the substance which is formed in the chlorophyll-corpuscles of the Musaceæ, without being aware, apparently that Briosi's results have been shown to be incorrect by Holle and Godlewski ("Flora" 1877)

After having stated his own views, Prof. Pringsheim proceeds to criticise the current hypotheses concerning the function of chlorophyll. The first of these is the one according to which chlorophyll is itself converted into carbohydrate in the assimilatory process. It is not easy to understand, from a chemical point of view, how such a conversion can be effected in the plant, and it becomes quite impossible when it is shown, as Prof Pringsheim has done, that chlorophyll does not undergo any perceptible change when it is exposed to light in an atmosphere containing carbonic acid but no oxygen. The second relates to the absorption-spectrum of chlorophyll. The question naturally arises as to whether or not the rays which chlorophyll absorbs are those which effect the reduction of carbonic acid and water in the chlorophyll-corpuscle That it must be answered in the negative is clear when it is borne in mind that the maximum, of the decomposition of carbonic acid does not coincide with the maximum of absorption in the chlorophyll-spectrum From what source, then, is the energy derived which is necessary for this reduction? It is derived, according to Prof Pringsheim, from light-rays absorbed, not by the chlorophyll, but by the other cell-contents He is of opinion that the chlorophyll takes no direct part in this process

The next question which is dealt with is the existence of an optimum intensity of light for the decomposition of carbonic acid Prof Pringsheim does not consider that this is the intensity which effects the greatest evolution of oxygen, for, from his point of view, the amount of oxygen given off at any time is the resultant of the action of two distinct processes, respiration and assimilation, both of which are affected by the intensity of the light. He concludes that, so far as an actual gain of carbon is concerned, there is no general optimum intensity He applies this mode of reasoning also to the question of the relative activity of the different rays of the spectrum in the process of assimilation The green and yellow rays have been found to be more active than the blue, because, as he points out, they are not absorbed to the same extent by the chlorophyll, and not because they are endowed with any special reducing power Finally, he proceeds to the discussion of the fact that the volume of an atmosphere in which green plants are exposed to light remains constant This fact has led to the conclusion that, since the volume of carbonic acid decomposed and of oxygen exhaled is the same, the substance formed in the process is a carbohydrate Prof Pringsheim's inference from this fact is very different He argues that since oxidation and reduction are going on simultaneously, the substance formed contains a smaller quantity of oxygen than a carbohydrate,—in fact a quantity which is smaller by just that amount of oxygen which has been used up in respiration

Stated in the briefest possible manner, Prof Pringsheim's principal results are as follows —

1 That the presence of chlorophyll favours the assimilatory activity of the chlorophyll-corpuscle in consequence of the absorption, by the chlorophyll, of light, which would promote the respiratory activity

2 That hypochlorin is the substance which is the first visible product of this assimilatory activity, and that the other substances (starch, glucose, oil, tannin) which are found in chlorophyll-corpuscles are derived from hypochlorin by oxidation This conclusion is based upon the general occurrence of hypochlorin in chlorophyll-corpuscles, upon the fact that the amount of hypochlorin in a corpuscle varies inversely as the quantity of starch which is present, and upon the observation that hypochlorin cannot be detected in seedlings until they have been exposed to light of such an intensity as to enable them to assimilate.

It is of interest to note that hypochlorin makes its appearance at the later stages of germination in seed-

lings of various species of Pinus which have grown in the dark, inasmuch as it has long been known that these plants become green in darkness.

This paper cannot be regarded as other than a most important contribution to our knowledge of the physiology of plants, and it will be readily admitted that Prof Pringsheim's theory of the function of chlorophyll is at least as satisfactory as any which are now current But although the number of facts upon which the theory is based is large, yet the evidence in favour of it can hardly be considered to be complete at present, there are certain points which require further elucidation For instance, Prof. Pringsheim regards the chlorophyll of a corpuscle as undergoing no change under ordinary circumstances, but it is difficult to reconcile this view with the fact that an alcoholic solution of chlorophyll loses its colour under the same circumstances. Then again, as to the source of the reducing energy in the process of assimilation, if the rays absorbed by the chlorophyll are not directly concerned in it, it is most desirable that more information should be obtained as to the nature of the rays which are active, and as to the particular cell-contents which absorb them Further, the correctness of the principle that an increase in the intensity of light to which a cell is exposed produces an increase of its respiratory activity, needs more direct and general experimental confirmation than is given here In his views as to the respiratory function, he appears to insist too strongly that the chlorophyll-corpuscles are to be regarded not only as assimilatory, but also as respiratory organs. It is not easy to see that any of the observations which he gives in this paper directly suggest such a view, on the contrary, they tend rather to show that exposure to intense light increases oxidation in the *whole* of the protoplasmic cell-contents Prof Pringsheim evidently desires to bring out that hypochlorin is *the* substance which undergoes oxidation in the cell, and since it is present exclusively or nearly exclusively in the chlorophyll-corpuscles, he considers that these bodies are the especial seats of the respiratory process. His observations, however, do not warrant this conclusion, what they prove is that the hypochlorin in the chlorophyll-corpuscles is oxidised when they are exposed to intense light in an atmosphere containing oxygen, and that certain changes (including a loss of substance) take place in the rest of the protoplasm, in consequence, doubtless, of the excessive oxidation of some substance or substances which it contains His view may be fairly met with the *à priori* objection that it is highly improbable that the same organ should be the seat of two such opposite functions as respiration and assimilation. The true physiological significance of the chlorophyll-corpuscles becomes apparent when it is borne in mind that assimilation does not take place in cells which do not possess them, whereas respiration proceeds actively, perhaps most actively, in such cells.

And, finally, as to hypochlorin, it is to be hoped that a method will be devised for the extraction of this substance in such quantities as to allow its properties to be studied and its chemical composition to be ascertained. The curious fact that hypochlorin cannot be detected in plants which are not distinctly green (Diatomaceæ, Fucaceæ, &c), is worthy of further investigation.

These desiderata may perhaps be supplied in the future publications on this subject which Prof Pringsheim promises SYDNEY H. VINES

NOTES

WE take the following from the *Times* —At their meeting last week the President and Council of the Royal Society selected, from the whole number of fifty-two candidates for the fellowship, the following fifteen to be recommended to the Society for election at the annual meeting on June 2 next —W. E. Ayrton, H. W. Bates, J. S. Bristowe, W. H. M. Christie, G. Dickie, A. B. Kempe, A. Macalister, H. McLeod, J A Phillips, W. H. Preece, B. Samuelson, M.P , B. B. Stoney, R H. Traquair, Rev. H. W. Watson, C. R. A Wright.

A *conversazione* of the Society of Telegraph Engineers was held in honour of Prof. Helmholtz in the rooms of University College on Monday night. Among those who were present to meet the guest of the evening were many eminent English men of science. Many of the members of the Society and other had lent instruments and apparatus showing some of the purposes to which electricity has recently been applied, and also the means by which electrical research is still being carried on. On entering the College grounds the visitors saw a very pretty effect caused by one of Mr. Crompton's electric lights, which had been placed on the top of the portico The reception-room itself was lit up with little incandescent electric lamps on Mr Swan's principle They were arranged in bunches of three or four in ground glass globes suspended from the ceiling, and in fact at first sight they looked like very brilliant gas-burners, no wires being visible. On each side and down the centre of the room were placed tables on which were arrayed all the newest inventions in electrical science. On one it was demonstrated how perfectly easy it was to manage Mr. Swan's lamps, taking one lamp out of the stand and putting in a new one occupying only a few seconds, there being no binding-screws or switches to attend to Perhaps the most interesting experiment of the evening was the transmission of pictures of natural objects by telegraph, the picture of a butterfly being most beautifully transmitted by means of a selenium plate. This was shown by Mr. Shelford Bidwell's telephotographic machine Mr. Latimer Clark exhibited some rare books on electricity and magnetism, autographs and portraits of eminent electricians; also a portion of the original telegraph line which was laid by the late Sir Francis Ronalds in 1816, with the original model of Ronalds' telegraph, the original type cast for the Morse telegraph, with autograph of Prof. Morse, and a portion of line laid by W. F. Cooke in 1837 Mr. Cotterell of the Royal Institution exhibited a very delicate mercury electrometer on Lippman's principle, belonging to Prof. Dewar; and Mr. Robert Sabine performed some pretty experiments illustrating the cause of the motion of the mercury Mr. Stroh showed the beautiful apparatus made by him to illustrate Prof. Helmholtz's vowel theory, and Mr Preece performed several experiments in explanation of the remarkable sounds produced by intermittent light on solid, liquid, and gaseous matter. Mr. George Lund, of the firm of Messrs. Lund and Blockley, exhibited some synchronous clocks for the London, Chatham, and Dover Railway Company for coupling up two ordinary telegraph lines at 10 a.m., in order to send the time current. They also applied to the clock a novel automatic arrangement of their own invention, by which, at two minutes to 10 a m. daily, the current will ring a warning bell, couple up and block against false currents two ordinary telegraph wires, then at 10 a.m the clock sends the time-current of two seconds' duration, giving time to the clocks in circuit. Immediately upon the termination of the two seconds' current the lines will be automatically re-established as distinct lines for their ordinary telegraph purposes. All present were pleased to have the opportunity of inspecting Prof Kennedy's engineering laboratory, where the machine for testing the strength of materials up to fifty tons was seen in operation, and various pieces of brass and copper were tested. The machine-tools were in operation, and a steam engine of peculiar construction driving them. We look forward with interest to the scientific results we may expect to be brought to light with the testing-machine. The President (Prof Carey Foster) showed some interesting electrical instruments; Mr. Richard Anderson a portable galvanometer for testing lightning-conductors, Profes-

sors Ayrton and Perry a variety of apparatus, as also Siemens Brothers, Newall and Co., and others Prof Helmholtz ended on Tuesday his visit to London, and went with Mr Spottiswoode, president of the Royal Society, to his country house at Coombe Bank, Sevenoaks. From thence he proceeds to Dublin to receive an honorary doctor's degree from the University of that city

THE National Fisheries Exhibition will be opened at Norwich by the Prince of Wales on the 18th inst. The delay in opening it has been caused by the necessity for enlarging the space to admit of satisfying the numerous applications that have poured in. Every point connected with the growth and nurture of fish, the modes of capturing them, the condition of the fishermen will be illustrated The aquatic fauna of Norfolk and Suffolk will be a special feature, as also fish eating birds. The Earl of Ducie, Viscount Powerscourt, Lord Lovat, Mr Spencer Walpole, and Prof Huxley, H M. Inspectors of Fisheries, and Mr. Calcraft, Permanent Secretary to the Board of Trade, have been appointed by the Home Secretary to act as Her Majesty's Commissioners. In addition to a large number of special money prizes, Government gold, silver, and bronze medals, diplomas of honour, will be awarded by the jurors Prof Huxley will give an address on the occasion.

MUSEUM No I in the Royal Gardens, Kew, will be reopened to the public on Easter Monday, after being closed during the winter. It has been enlarged by the addition of a new wing, terminating in a wide staircase with ascending and descending flights The expense has been borne by the India Office in consideration of the maintenance at Kew of the botanico-economical collections recently forming part of the India Museum. The whole collections have been entirely re-arranged by the curator, Mr. John Jackson, A.L S. On the staircase has been placed a large painted window, presented to the museum by Alderman W J R Cotton, M.P This window represents the successive stages of cotton cultivation and manufacture Amongst other recent additions to the museum may be mentioned a series of models of farm and garden vegetables prepared and presented by Messrs Sutton of Reading; a collection formed by Col. Pearson, who has charge of the Indian forest-students at Nancy, of the various objects manufactured in France from native-grown woods, a further series of vegetable products and manufactured articles, collected in Afghanistan by Surgeon-Major Aitchison The collection of portraits of botanists has also been much enlarged and re-arranged An oil portrait of Thomas Andrew Knight, F.R S, well known for his classical researches in vegetable physiology, has been presented on behalf of the family by Sir Charles Rouse Boughton, Bart.

THE President of the United States of America has notified to the French Government his intention of appointing a special commission to preside over the arrangement of the American section at the Electrical Exhibition. A number of commissioners have been already selected for the purpose. M. Philippart has written to M. Berger, placing at his disposal a sum of 4000*l*. for the best system presented of transporting electric force at a distance.

ON Sunday week a deputation composed of eminent representatives of French science waited upon the venerable M Milne-Edwards to present him with a medal in commemoration of the completion of the great naturalist's work on Comparative Physiology and Anatomy. Warm congratulatory addresses were made by MM. Quatrefages, Blanchard, and Dumas, the last speaking of himself as the oldest of M. Milne-Edward's friends. In thanking the deputation the recipient of this well-earned honour was naturally much moved.

ON March 26, in presence of the Minister of the Interior, the Commission of the Observatory, several State functionaries and men of science, there were repeated at the Brussels Observatory experiments with Van Rysselberghes' telemeteorograph, which prove that the registration of the meteorological elements by this instrument may be made automatically at very great distances (several hundred kilometres) The author explained to the Minister a plan of International Telemeteorography, the realisation of which would be of the greatest utility for the scientific study of the atmosphere, and which would render possible the prevision of the weather.

THE destruction caused by the Chios earthquake has been even greater than we stated last week The Constantinople Correspondent of the *Daily News* sends some interesting particulars: The temperature on the 3rd was heavy and oppressive, and the horizon was broken by broad flashes of light that seemed to denote a coming storm In all this atmospheric disturbance however the inhabitants saw nothing extraordinary, and were far from being alarmed by what they fancied would result in a thunderstorm At ten minutes to two in the afternoon a terrific shock was felt, bringing three-fourths of the houses in the town to the ground like so many packs of cards, and burying a thousand persons under the falling ruins Then commenced a fearful scene of horror The ground rocked and danced, kneading the ruin already formed into an unrecognisable mass of stone The survivors ran hither and thither, not knowing where to flee to escape the horrible fate that menaced them, and were tossed and flung about by the heaving earth, like feathers in a breeze Even those who gained the open country were by no means safe The earthquake attacked not only the towns and villages, but worked its ravages in the hills and mountains of the island Enormous masses of rock and earth came rushing down the hill-sides, carrying all before them, bounding far into the plains, and tearing roads in the solid rocks of the mountain such as might have been formed by a torrent a thousand years old The town presented a pitiable spectacle. Great fissures and crevices yawned in the streets, walls were falling with a crashing report, and entire buildings crumbled in fragments to the ground In many places whole streets had disappeared, and it was hard to say where the different well-known buildings had stood. The ground still heaved and tossed, bringing fresh buildings to the ground at every moment, and hurrying innumerable victims to destruction. It is impossible to say what the number of victims would have been if a second shock had not displaced the ruins formed by the first and thus permitted thousands of sufferers to escape or to be rescued by others from the horrible imprisonment to which they had been condemned. All the fissures and crevices run from east to west. In the country the effects of the horrible upheaval have been even more terrible than in the town The shocks are now, April 8, diminishing. In all there were counted 250 since the first three awful upheavals which destroyed the greater part of the island A telegram of the 12th states that earthquake shocks of considerable violence have recommenced in Chios, and it is estimated that barely twenty houses now remain habitable in the whole island Forty-five villages have been totally destroyed, and in many localities the population has absolutely disappeared.

SOME slight shocks of earthquake were felt on the morning of the 5th inst. at San Cristobal, Cuba. A violent shock was felt at two o'clock on Sunday morning throughout the centre of California. Earthquakes were reported from South Hungary on Wednesday last week.

THE *Daily News* Naples correspondent, telegraphing on the 6th, states that Mount Vesuvius was displaying greater activity. Abundant streams of lava were descending northwards, and great numbers of smoke fissures had opened round the crater, some at 100 metres distance from the centre of eruption.

PROF. C. V RILEY has just published, in the Second Report of the United States Entomological Commission, "Further Facts about the Natural Enemies of Locusts," meaning, of course, by the latter term, the Rocky Mountain pest in particular His observations entirely concern insect parasites. The most interesting are on the habits of two species of *Diptera*, allied to *Bombylius*, the larvæ of which feed on the eggs of "locusts" The plate (xvi) illustrating the subject is above praise, not only on account of the scientific accuracy shown in the drawings (which are by the author), but also as regards the reproduction of them by the "lithocaustic" process adopted by a Baltimore firm We have seen other plates of entomological subjects emanating from the same firm, and the impression formed on our mind is that no other process is equally adapted for the purpose. Why cannot some of our own enterprising "lithographers" produce the same result?

THE following are the lecture arrangements after Easter, at the Royal Institution —Prof. Dewar, M A., F.R.S, six lectures on the Non Metallic Elements, on Tuesdays, April 26 to May 31, Prof Tyndall, D C L., F.R S., six lectures on Paramagnetism and Diamagnetism, on Thursdays, April 28 to June 2, Prof H Morley, three lectures on Scotland's Part in English Literature, on Saturdays, April 30, May 7, 14; one lecture on Thomas Carlyle, on Tuesday, June 7, Mr. E C. Turner, Lector at the University of St Petersburg, five lectures on the Great Modern Writers of Russia, on Saturdays, May 21, 28, June 4, Thursday, June 9, and Saturday, June 11. The Friday evening meetings will be resumed on April 29, at 8 p.m. Prof. J S Blackie, F R.S E., will give a discourse on "The Language and Literature of the Scottish Highlands," at 9 p m. Succeeding discourses will probably be given by the Hon G C Brodrick, Mr. Francis Galton, Mr W. H. Pollock, Prof H. E Roscoe, Prof. W. G Adams, and Prof Dewar

THE usual course of Mayfair Lectures will commence, under the auspices of the National Health Society, on Friday, April 22, at 23, Hertford Street, Mayfair The list of lecturers will this year include the names of Dr Siemens, F.R S, Dr Robert Farquharson, M.P, and Prof Fleeming Jenkin.

WE are glad to find from an announcement in the current number of the *Quarterly Journal of Microscopical Science* that Dr. C T Hudson, of Manilla Hall, Bristol, is preparing a volume for the Ray Society on the "British Rotifers" Dr Hudson is known not only for his numerous contributions to our knowledge of this group, but especially for his discovery and excellent illustrations of one of the most important members of the group (Pedalion). Dr. Hudson will have the advantage of the use of Mr P H Gorse's beautiful drawings of Rotifers, which that observer has placed at his disposal.

A LARGE party of the Members of the Geologists' Association were on Saturday last conducted through the Geological Department of the British Museum (Natural History), South Kensington, by Dr. Henry Woodward, F RS, &c., the Keeper of that Department.

Apropos of the meeting of the French Association at Algiers the *Revue Scientifique* for April 9 devotes most of its space to a series of articles on Algeria, its colonisation, statistics, botany, anthropology, hygiene, and zoology.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. R J. Short; a Common Paradoxure (*Paradoxurus typus*), from India, presented by Mr. C W. C. Fletcher; a Viverrine Cat (*Felis viverrina*) from India, presented by Major C. R. Oxley: two Squirrel-like Phalangers (*Belideus sciureus*) from Australia, presented by Mr D. W. Barker, three Paradise Whydah Birds (*Vidua paradisea*), a Pin-tailed Whydah Bird (*Vidua principalis*), a Red shouldered Weaver Bird (*Urobrachya axillaris*), a Red-beaked Weaver Bird (*Quelea sanguinirostris*), a Wiener's Finch (*Pytelia wieneri*), two Yellow rumped Seed Eaters (*Crithagra chrysopyga*) from Mozambique, presented by Mr Maurice C Angel, F.Z S., two Laughing Kingfishers (*Dacelo gigantea*) from Australia, presented by Mr Edward Trelawny, an Alexandrine Parrakeet (*Palæornis alexandri*) from India, presented by Mr Henry Day, a Common Gannet (*Sula bassana*), British, presented by Mr G Randall, a Common Marmoset (*Hapale jacchus*) from South America, deposited; an Indian Chevrotain (*Tragulus meminna*) from India, six Weeper Capuchins (*Cebus capucinus*) from Brazil, four Chestnut-eared Finches (*Amadina castanotis*) from Australia, three Common Crowned Pigeons (*Goura coronata*) from New Guinea, an American Tantalus (*Tantalus loculator*) from South America, purchased, two Sclater's Curassows (*Crax sclateri* ♂ ♀) from South America, on approval, an Indian Darter (*Plotus melanogaster*) from India, received in exchange.

GEOGRAPHICAL NOTES

THE Royal Medals of the Geographical Society have this week been awarded as follows —The Founder's Medal to Major Serpa Pinto, "for his remarkable journey across Africa, from Benguela to Natal, during which he explored nearly 500 miles of new country, defined the fluvial systems of the southern slopes of the Benguelan Highlands, and fixed the position of numerous places by a series of astronomical observations, also for the admirable account of his journey, now in course of publication in London, containing numerous original maps, tables of observations, and a large amount of valuable and exact information regarding the African interior," and the Patron's Medal to Mr Benjamin Leigh Smith, for his discoveries on the south coast of Franz-Josef Land during last summer, as well as for his previous exp ditions along the north east land of Spitzbergen

AT the meeting of the Geographical Society on Monday last Mr. R. N. Cust read a paper by Col Tanner on Kafiristan and the Siah-posh Kafirs of the Hindu Kush. The paper, which was hardly a geographical one in any sense, dealt chiefly with the inhabitants of the Valley of Dara Nur and the Chugani tribe, and to a less extent with the Kafirs, who are called "Siah-posh" from their wearing black clothes, and furnished some very interesting information regarding their manners and customs Some philological notes had also been sent by Col. Tanner, but these will be communicated to the Asiatic Society. Some of the more striking passages in Col. Tanner's notes, if we remember rightly, were read at the Swansea meeting of the British Association. As much interest attaches to Kafiristan and the Kafirs, and the results expected from Col Tanner's expedition were so eagerly looked forward to, it was rather disappointing to be told by Col Yule that we have even now learned no more than was buried in the record of a Jesuit Missionary's travels some 200 years ago. No doubt had his health not failed at the critical moment, and compelled him to return to India, Col Tanner would have succeeded in penetrating into Kafiristan itself, and collected valuable geographical information.

THE Society formed at Milan for commercial exploration in Africa is showing increased activity, and has despatched another expedition to Tripoli, under the command of Capt. Camperio, who is accompanied by Signor Cingia, an ex-cavalry officer The principal objects of this expedition are the exploration of the Gulf of Bomba, and it will particularly examine the ports of Tobruk and Derna, not far from the Egyptian frontier. Capt. Camperio will afterwards make an attempt to penetrate into the interior of the oasis of Jazabud, in order to open commercial relations with its inhabitants

WE are glad to learn that there is good hope that Col. Flatters and many of his followers, who were reported to have been massacred by the Touaregs, are still alive, though probably retained as prisoners.

DOCTORS SCHWEINFURTH AND RIEBECK, who have been travelling in Egypt left Cairo last month to explore the island of Soc

Prof. I. B. Balfour visited the island on behalf of our Zoological Society.

THE April number of *Petermann's Mittheilungen* has a long article, with map, on Mr A. Forrest's expedition through North-West Australia in 1879, Herr Clemens Denhardt continues his paper on Researches in Equatorial East Africa; Herr F v. Stein gives details on the new French land fortifications, with map, and there are several interesting letters from Dr. Junker, on his experiences in the Niam-Niam country.

No. 2, for 1880, of the *Bulletin* of the American Geographical Society contains an unusually interesting paper by Prof. J. B. M'Master, of Princeton College, on the Bad Lands of Wyoming, in which he endeavours to trace out their geological history, Mr. B. R. Curtis describes his journey round the world, and there is a historical article on Arctic Exploration by the Rev B. F De Costa.

THE *Bulletin* of the Antwerp Geographical Society (tome v fasc. 6) contains a paper of considerable value by the Abbé van den Gheyn, on the present state of research with regard to the primitive cradle of the Aryan race. M. A Baquet contributes a paper on the fauna and the chace in the countries of South America watered by the Paraguay and the Parana.

CHEMICAL NOTES

B. HEINDL has recently made investigations into the compounds of calcium chloride with ethyl alcohol, isobutyl alcohol, and amyl alcohol, and has obtained the following formulæ:—

$CaCl_2 . 3(C_2H_6O)$; $CaCl_2 . 3(C_4H_{10}O)$; and $CaCl_2 . 3(C_5H_{12}O)$

IN continuation of his investigation of the action of hydrochloric acid on metallic chlorides, already referred to in these notes, M. Ditté describes several new compounds of this acid with mercuric chloride, viz,

$$2HgCl_2 . 4HCl . 7H_2O . 3HgCl_2 . 4HCl . 7H_2O \cdot$$
$$2HgCl_2 \; HCl \; 6H_2O . 4HgCl_2 . 2HCl \; 9H_2O \quad \text{and}$$
$$3HgCl \, . \; HCl \; 5H_2O.$$

MM. FOUQUÉ AND LÉVY describe (in *Compt rend*) the artificial preparation of the basaltic minerals peridote and labradorite, by prolonged heating of a homogeneous mixture of the constituents of a basalt rich in olivine

DR. A. R LEEDS has recently examined the action of nitrogen tetroxide—N_2O_4—on various hydrocarbons (*Journ.* of American Chem Soc.). The results are interesting, and promise to be even more so Benzene, when acted on by N_2O_4 yields mononitro-benzene, picric acid and oxalic acid, two other compounds were also obtained, but under conditions which have not been successfully realised a second time. One of these the author calls monoxy-benzene—C_6H_4O—an isomer or metamer of quinone, the other has not been purified. Naphthalene yields mononitro-naphthalene, α and β dinitro-naphthalene, and two compounds which, so far as they have been examined, appear to be napthodiquinone, $C_{10}H_4O_4$, and tetroxy-naphthalene, $C_{10}H_8O_4$. The products of the action of nitrogen tetroxide on cymene are chiefly α nitrocymene (probably also a dinitro derivative) and paratoluic acid.

THE American Chem. Soc. *Journal* (vol. i. Nos. 11 and 12) contains an interesting historical sketch of the lines of discovery of ozone, and of peroxide of hydrogen, by Dr. A R Leeds; to these papers is added a full list of references to all publications on ozone and hydrogen peroxide; the ozone references occupy thirty-two pages, and the hydrogen peroxide, ten pages.

AN important paper by M. Étard—important both by reason of the results obtained and because of the nature of the problem attacked—on the oxidising action of chromyl dichloride, appears in *Annales Chim. et Phys.* for February M. Étard has studied the mechanism, so to speak, of the chemical changes which occur when chromyl dichloride acts as an oxidiser; he finds that in the case of the hydrocarbons containing methyl groups attached to an "aromatic" nucleus the methyl groups are transformed into the aldehydic group (COH), and that when the aromatic nuclei are themselves attacked, quinones are produced. The chromyl dichloride forms compounds with the aromatic hydrocarbons, which may be formulated as $X . 2CrO_2Cl_2$ (where X = hydrocarbon): these compounds are then decomposed by water, and yield the products already mentioned

IN the same journal there is a lengthy and interesting paper by M. W. Spring on the effects of great pressure on solid bodies. It is shown in this paper—which is chiefly physical—that the particles of crystalline bodies tend to solder themselves closely together at high pressures, the effect of pressure being analogous to that of fusion, and that amorphous bodies may be divided into two classes, viz. those which behave similarly with crystalline bodies, and those which are not thus affected by high pressures

THE influence of pressure on chemical changes is also considered, and it is shown that as a general rule a chemical change which results in the production of a system the volume of which is less than the volume of the initial system, may be brought about by subjecting the initial system to great pressure, but that if the change involves an increase of volume, pressure alone does not cause the change to proceed.

M. BRAME describes (in *Compt. rend*) experiments on animals with pure hydrocyanic acid, the results of which seem to show that the bodies of animals killed by this acid (pure) do not undergo decomposition even when kept for a month, that the acid remains during that time in the animal tissues, and notably in the stomach, and that the acid is readily obtained by distillation from the tissues of a herbivorous, but much less readily from those of a carnivorous animal.

IN continuing his researches on chemical affinity Herr Ostwald (*Journ fur pract. Chem*) has made the remarkable observation that while the solvent action of polybasic acids on salts is diminished by the presence of the normal salts of the acids employed, the solvent action of monobasic acids is considerably increased by the presence of the normal salts of these acids In his third paper Herr Ostwald gives a large series of measurements which show that the solvent action of free nitric or hydrochloric acid on calcium or zinc oxalate is increased by addition of potassium, sodium, ammonium, or magnesium nitrate or chloride. The solvent action increases proportionally to the increase in the quantity of normal salt added. Ostwald confesses that he can as yet give no thoroughly satisfactory explanation of this phenomenon, the explanation which appears at present most probable involves the assumption that there is a slight chemical action between the normal salt (potassium nitrate, &c.) and the salt which is being dissolved by the acid (calcium or zinc oxalate): this small chemical change alters the "stability" of the whole system, and so increases the amount of the primary change, *i.e* solution of calcium oxalate, &c, in a given time.

FROM thermochemical data J. Thomsen regards the generally accepted formula for benzene as incorrect. The number obtained by him for the heat of combustion of benzene (805,800 thermal units) agrees fairly well with that calculated (800,400), on the assumption that all the carbon atoms in benzene are "singly-linked." The heat of combustion of the metamer of benzene, viz. dipropargyl, is, according to Berthelot, 853,600 units, Thomsen's calculations, assuming the formula

$$HC{\equiv}C{-}CH_2{-}CH_2{-}C{\equiv}CH$$

to be correct, give the number 888,400. The formula above given for dipropargyl is therefore probably correct.

IN the last number of the German Chemical Society's *Berichte* are published some recent observations on dipropargyl by Henry, the discoverer of this curious compound. He describes, but not yet in any detail, a solid polymer produced by the action of heat on dipropargyl. He also describes the tetriodide $C_6H_6I_4$, and the octobromide $C_6H_6Br_8$.

THE arguments in favour of the number 240 being adopted as the atomic weight of uranium have been strengthened by the preparation by C. Zimmermann (*Berliner Berichte*) of the normal uranate of lithium, Li_2UO_4, analogous with the normal chromates, tungstates, and molybdates.

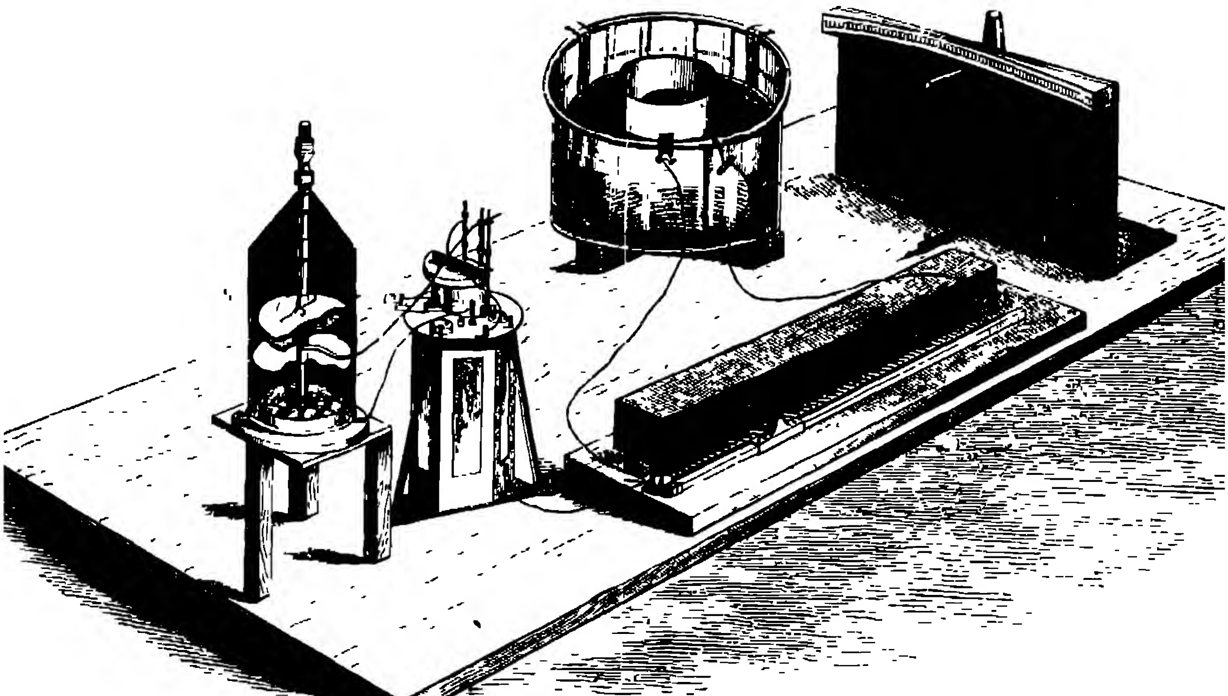
IN the *Chem. Soc. Journ* for March Dr. Ramsay continues his investigations on atomic and molecular volumes; he adduces evidence in support of the number 7 as representing the atomic volume of nitrogen, the generally-accepted number is 2·3 He also shows that the molecular volumes of compounds of the benzene, naphthalene, and anthracene series are smaller than those calculated from the best established atomic volumes of the constituent elements, and his numbers suggest that the condensation in these compounds may very probably be proportional to the number of carbon atoms in each molecule, and also to the manner of "linking" of these atoms.

ON A METHOD OF MEASURING CONTACT ELECTRICITY[1]

IN my reprint of papers on electrostatics and magnetism (§ 400, of date January, 1862) I described briefly this method, in connection with a new physical principle, for exhibiting contact electricity by means of copper and zinc quadrants substituted for the uniform brass quadrants of my quadrant electrometer. I had used the same method, but with movable disks for the contact electricity, after the method of Volta, and my own quadrant electrometer substituted for the gold leaf electroscope by which Volta himself obtained his electric indications, in an extensive series of experiments which I made in the years 1859–61

I was on the point of transmitting to the Royal Society a paper which I had written describing these experiments, and which I still have in manuscript, when I found a paper by Hankel in Poggendorff's *Annalen* for January, 1862, in which results altogether in accordance with my own were given, and I withheld my paper till I might be able not merely to describe a new method, but if possible add something to the valuable information regarding properties of matter to be found in Hankel's paper. I have made many experiments from time to time since 1861 by the same method, but have obtained results merely confirmatory of what had been published by Pfaff in 1820 or 1821, showing the phenomena of contact electricity to be independent of the surrounding gas, and agreeing in the main with the numerical values of the contact differences of different metals which Hankel had published; and I have therefore hitherto published nothing except the slight statements regarding contact electricity which appear in my "Electrostatics and Magnetism." As interest has been recently revived in the subject of contact electricity, the following description of my method may possibly prove useful to experimenters. The same method has been used to very good effect, but with a Bohnenberger electroscope instead of my quadrant electrometer, in researches on contact electricity by Mr. H. Pellat, described in the *Journal de Physique* for May 1880.

The apparatus used in these experiments was designed to secure the following conditions:—To support two circular disks of metal about four inches in diameter in such a way that the opposing surfaces should be exactly parallel to each other and approximately horizontal, and that the distance between them might be varied at pleasure from a shortest distance of about one fiftieth of an inch to about a quarter or half an inch. This part of the apparatus I have called a "Volta-condenser." The lower plate, which was the insulated one, was fixed on a glass



stem rising from the centre of a cast-iron sole plate. The upper plate was suspended by a chain to the lower end of a brass rod sliding through a steadying socket in the upper part of the case. A stout brass flange fixed to the lower end of this rod bears three screws, one of which, S, is shown in the drawing, by which the upper plate can be adjusted to parallelism to the lower plate. The other apparatus used consisted of a quadrant electrometer, and in my original experiments an ordinary Daniell's cell, in my later ones a gravity Daniell's cell of the form which I described in *Proc.* R.S. 1871 (pp. 253–259) with a divider by which any integral number of per cents. from 0 to 100 of the electromotive force of the cell could be established between any two mutually insulated homogeneous metals in the apparatus.

Connections.—The insulated plate was connected by a brass wire passing through the case of the Volta-condenser to the electrode of the insulated pair of quadrants. The upper plate was connected to the metal case of the Volta-condenser and to the metal case of the electrometer, one pair of quadrants of which were also connected to the case. One of the terminals of the divider, which connected the poles of the cell, was connected to the case of the electrometer, and to the other terminal was attached one of the contact wires, which was a length of insulated copper wire having soldered to its outer end a short piece of platinum. The other contact surface was a similar short piece of platinum fixed to the insulated electrode of the electrometer. Hence it will be seen that metallic connection between the two plates was effected by putting the divider at zero and bringing into contact the two pieces of platinum wire.

Order of Experiment.—The sliding piece of the divider was put to zero, and contact made and broken and the upper plate raised then the deflection of the spot of light was observed. These operations were repeated with the sliding piece at different numbers on the divider scale until one was found at which the make-break and separation caused no perceptible deflection. The number thus found on the divider scale was the number of per cents. which was equal to the contact electric difference of the plates in the Volta condenser.

[*Addendum*, November 23, 1880.—Since the communication of this paper to the British Association, I have found that a dry platinum disk, kept for some time in dry hydrogen gas, and then put into its position in dry atmospheric air in the Volta-condenser, becomes positive to another platinum disk

[1] By Prof. Sir William Thomson, M.A., F.R.S., being a paper read before Section A of the British Association at Swansea, 1880, with additions

which had not been so treated, but had simply been left undisturbed in the apparatus. The positive quality thus produced by the hydrogen diminishes gradually, and becomes insensible after two or three days.]

P.S.—On December 24, 1880, one of two platinum plates in the Volta-condenser was taken out, placed in dried oxygen gas for forty-five minutes; taken out, carried by hand, and replaced in the Volta-condenser at 12.30 on that day. It was then found to be negative to the platinum plate, which had been left undisturbed. The amount of the difference was about ·33 of a volt. The plates were left undisturbed for seventeen minutes in the condenser; and were then tested again, and the difference was found to have fallen to ·29 of a volt. At noon on the 25th they were again tested, and the difference found to be ·18. The differences had been tested from time to time since that day, the plates having been left in the condenser undisturbed in the intervals. The following Table shows the whole series of these results:—

Time	Electric difference between surfaces of a platinum plate in natural condition, and a platinum plate after 45 minutes' exposure to dry oxygen gas.
Dec. 24, 12.30 p.m.	·33 of a volt.
24, 12.47 p.m.	·29 ,,
25, noon	·18 ,,
27, noon	·116 ,,
28, 11.20 a.m.	·097 ,,
31, noon	·047 ,,
Jan. 4, 11.0 a.m.	·042 ,,
11, 11.40 a.m.	·020 ,,

Mr. Rennie, by whom these experiments were made during the recent Christmas holidays, had previously experimented on a platinum plate which had been made the positive pole in an electrolytic cell with an electromotive force of one volt, tending to decompose water acidulated with sulphuric acid, the other pole being a piece of platinum wire. After the plate had been one hour under this influence in the electrolytic cell he removed it, and dried it by lightly rubbing it with a piece of linen cloth. He then placed it in the Volta-condenser, and found it to be negative to a platinum plate in ordinary condition, the difference observed was ·27 of a volt. This experiment was made on October 21, and on November 8 it was found that the difference had fallen from ·27 to ·07. Mr. Rennie also made similar experiments with the platinum disk made the negative pole in an electrolytic cell, and found that this rendered the platinum positive to undisturbed platinum to a degree equal to about ·04 of a volt. The effect of soaking the platinum plate in dry hydrogen gas, alluded to in my first postscript, which also was observed by Mr. Rennie, was found to be about ·11 of a volt. Thus in the case of polarisation by hydrogen, as well as in the case of polarisation by oxygen, the effect of exposure to the dry gas was considerably greater than the effect of electro-plating the platinum with the gas by the electromotive force of one volt.

THE NAVAL ARCHITECTS

THE session of the Institution of Naval Architects just concluded was remarkable for the number of papers on the use of steel both for shipbuilding and marine engineering. This was perhaps to be expected in consequence of the commotion among steel-users caused by the total failure of the steel plates supplied for the boilers of the Russian yacht *Livadia*. Accordingly we find four papers on this subject. The first, by Mr. Samuda, deals with the effect which the introduction of steel hulls and steel-faced armour has had upon the design of ships of war. This paper is based upon the results attained by the author with a steel corvette which he has recently constructed for the Argentine Government. The dimensions of this vessel as actually constructed, and the corresponding dimensions which must of necessity have been adopted, had the material of construction been iron instead of steel, should be carefully noted in order to appreciate the true benefits to be derived from the use of the latter material.

The vessel as actually constructed is 240 feet long by 50 feet wide; the displacement is 4200 tons, the power 4500 horses, and the coal-supply 650 tons, which is sufficient to allow her to steam 6000 miles at a speed of 8 knots, or 4300 miles at a speed of 10 knots. The speed which it is expected will be attained on the measured mile is 13¾ knots. If the vessel had been built of iron and cased with iron armour, the speed and shot-resisting power remaining the same, the dimensions would have been as follows:—Length, 260 feet; breadth, 55 feet; displacement, 5200 tons; power, 5000 horses, and coal-supply, 720 tons. This example is a very good illustration of the great benefit which naval architects will derive from the use of steel, a benefit, be it remarked, which comes most opportunely in these days of powerful ordnance, for not only has the steel-faced armour about 25 per cent. more resisting power than an equal thickness of iron, but also the weight saved in the hull and machinery by the use of steel enables a greater quantity of armour to be carried.

The second paper on steel was by Mr. W. Parker, Chief Engineer Surveyor to Lloyd's Registry, "On the Causes of the Failure of the Steel Plates supplied for the Boilers of the *Livadia*." Steel, as is well known, had formerly a bad reputation for treachery and uncertainty of behaviour. Latterly however a more intimate knowledge of the methods of manufacture and a better acquaintance with the processes of working had apparently quite removed this impediment to its general introduction. The failure therefore above referred to came as a surprise to shipbuilders, and the circumstances demanded and received a most searching inquiry at the hands of the engineer officers of Lloyd's. It was found that samples cut from the broken plates fulfilled every test demanded by Lloyd's, the Admiralty, and the Board of Trade. The tensile strength proved to vary between the very narrow limits of 26·1 and 28·3 tons per square inch. The elongation after fracture of samples 8 inches in length ranged from 27·3 to 34·3 per cent. Nevertheless in spite of the apparently excellent quality of the plates, it was found that after they had been punched and worked into place they had become so brittle as to be unable to stand the hydraulic proofs to which it is usual to subject boilers, and in some instances even, the plates cracked before the hydraulic test was applied. The further investigations of Mr. Parker proved that whenever samples of the plates were punched, the material became so brittle as to break into pieces under the blow of an ordinary sledge-hammer, the tensile strength dropped to 18·4 tons per square inch, and the extensibility disappeared altogether.

Specimens were next subjected to chemical analysis, with the result of proving that, the material was from the chemical point of view far from homogeneous. A portion of the plates, about 8 inches long by 4 inches wide, was carefully freed from rust by grinding, and successive layers were planed off from one side to the other. Each layer was one-sixteenth of an inch in thickness, and they were numbered in succession as they were planed off. The result of analysis showed that the quantities of carbon, manganese, sulphur, and phosphorus varied in an extraordinary degree. These differences in the chemical composition, however, did not satisfactorily account for the behaviour of the metal. It was not till the appearance of the fractures suggested, that the material had not been properly worked under the hammer and rolls, that a really satisfactory solution of the mystery was arrived at. "A piece cut from the fractured plate was raised to a red heat and rolled to half its original thickness. Strips were then cut from this ⅜ inch plate, and punched with holes ⅜ inch diameter, being one half the size of those in the ¾-inch plate. This extra work on the material seemed to raise its ductility appreciably, the strips being found to bend well after punching, several of them bending to right angles, and only one of them breaking short off, while none of them showed such extraordinary signs of brittleness as were observable in the material when of the original thickness. Three pieces tested for tensile strength after rolling broke under a stress of 33 tons, 34·25 tons, and 32·3 tons per square inch respectively, with an elongation in 8 inches of 12 per cent., 11·25 per cent., and 17·5 per cent. respectively, the last-mentioned specimen being annealed."

Mr. Parker concludes his paper by expressing the hope that the facts which he was able to lay before the meeting will tend to allay alarm and to strengthen confidence in the use of mild steel for constructive purposes. When it is considered what an enormous quantity of this material is now being used in the construction of marine boilers, as well as for the hulls of vessels, this wish will be heartily re-echoed. In the spring of 1878 there were only two marine boilers of the modern form made of mild steel in existence. Within twelve months subsequently to that date 120 steamers had been fitted with boilers of this material, and during the same period in the following year 280 vessels more. At the present moment there are no less than 1100 steel boilers in use in steamships, weighing together over 17,000 tons.

The third paper on steel was by Mr J. R. Ravenhill, and gave an account of the improvements which have recently been made in mild steel castings. Many portions of machinery and steam-engines which till quite recently were invariably made of cast iron can now be formed of cast steel, with the attendant advantages of gain in strength and saving in weight.

Perhaps the most interesting paper of the four was that by M. Berrier Fontaine, the eminent French naval architect, "On the Use of Mild Steel for the Construction of the Hulls of Ships in the French Navy." The French were undoubtedly the first to introduce this material into the national navy, but though their experience of it is longer than our own, they do not seem to have acquired the same confidence in its use which is now felt in this country. For instance, we are in the habit of constructing the entire hulls of ships, including the below-water plating, of steel, the French, on the other hand, continue to use iron for all work which has to be exposed to the action of sea water. The reason advanced is that they find that steel when immersed in salt water corrodes with far greater rapidity than iron. M. Berrier Fontaine quotes as examples two gunboats, the *Épée* and the *Tromblon*, the hulls of which, completely steel-plated, have both given proof of rapid and deep corrosion. "The *Tromblon* was launched at Toulon on January 20, 1875, and remained afloat till October 27 of the same year. During that period of nine months it was found necessary to dock her three times, that it is to say, about every two months to paint the hull, the plates being rapidly and deeply attacked, especially in the neighbourhood of the water-line. The progress of this corrosion went on with such unusual rapidity, that when the time came to pass the *Tromblon* into the reserve it was thought necessary to haul her on to a slip instead of keeping her afloat." The whole subject of the corrosion of steel plates is at present involved in great mystery, and no two authorities seem able to agree about the cause. In the English Admiralty it is commonly believed that it is due to the presence on the surface of the plates of portions of black oxide, which constitute with the steel so many active galvanic couples, which of course rapidly promote corrosion, and hence great care is now taken to remove all traces of this oxide before the plates are coated. Whatever may be the cause, it is perfectly certain that the experience of English builders does not tally with that of M. Berrier Fontaine in this particular. Certain cases of corrosion have no doubt occurred in this country, and the hull of the *Iris* is an example in point, but as far as present experience goes such cases are the exception instead of the rule.

M. Berrier Fontaine gives an interesting account of the tools and other plant used in the French dockyards for the working of steel. He describes also the early difficulties which the workmen experienced, all of which have been successfully overcome. As regards the process of manufacture adopted in France, it appears that equally good results are obtained from the Bessemer and the Siemens methods, so much so that when contracts are given out it is never specified that the material is to be prepared by either of the two processes. In some works the Siemens system is employed for the superior sorts of steel, and the Bessemer process reserved for inferior descriptions, such as rails, while in other works exactly the opposite takes place. In this country, on the contrary, it is almost universally the rule to specify the Siemens process for the production of mild steel plates for ship-building and for boiler purposes.

DUNES AND MOVING SANDS

In a communication made to the Russian Society of Naturalists, M. Sokoloff has given a description of the dunes which are seen close by Sestroryetsk, at the eastern end of the Gulf of Finland. The whole of the isthmus between the Gulf and the basin of Sestroryetsk is covered with dunes which have a double origin. Those which are close by the sea-shore are old shore-ridges, mostly covered with vegetation, parallel to one another, and having each the form of a straight line, while those which are situated more east are true dunes, built up of sand driven by the wind. They have the direction north and south, and they reach the height of a hundred feet. Several of them are quite covered with pine-forests and with moss, while others are almost quite naked. The latter are constantly brought into motion by the west wind, and south of the Sestra River a high dune will shortly cover the houses of the working men of the Sestroryetsk manufactory. This dune, about 700 feet broad, has already covered several houses, and it is always advancing further, forming smaller parallel dunes fifteen feet high, its western side is covered with numerous excavations, from which the wind has taken the sand to move it further east. M. Sokoloff, while agreeing with the well-known classification of dunes established by the explorer of Sahara, M. Vatonne, thinks that the dunes of the deserts, which owe their origin to the action of wind, might be very easily distinguished from the mostly lower ridges which appear on the sea-shores under the influence of waves, these last usually having the form of straight lines, whilst the true dunes always have a semicircular form. M. Severtzoff observed after this communication that in the steppe of Kyzyl-koum, true dunes often have the same form of parallel, quite straight ridges. However, having at their origin a circular form which is so characteristic of the *barkhans* of the steppe, they lose by and by this form, and several smaller dunes, uniting together at their ends, take the form of a long straight ridge perpendicular to the prevailing direction of wind. M. Moushketoff, who has made a close acquaintance with the sands of Central Asia, observed that these sands, which are all sporadic, being spread among older formations, are very different as to their extent, their stratigraphical and petrographical characters, and their origin. They might be subdivided into three different classes:—1. Those which have a marine origin and which might be observed on the south-eastern shores of Lake Aral, and especially in the Kara-koum steppe. They are about 250 yards and 70 feet high, and mostly parallel to the shore. They are typical marine dunes, but their extension closely depends upon the extension of the Aralo Caspian formation, the fossils of which are always found broken in these sands. 2. The fluvial dunes, which are very common in the valleys of the Amou, Syr, Sourkhan, and others; their height rarely exceeds 10 to fifteen feet, and their length is from 100 to 150 feet, their sand is steel-gray, and contains gypsum and clay. 3. The *barkhans* are subaerial formations; they prevail in the central part of the steppe Kyzyl-koum, but are rather rare in the Kara koum steppe. They have the form of a sickle, and are somewhat conical, their maximum height being as much as 20 to 30 feet, their slopes are very different, that which is under the influence of the wind having an inclination from 5 to 13 degrees, whilst the other slope is short and steep, the inclination reaching sometimes as much as 43 degrees, they consist of a dirty-yellow or red sand, owing to their origin in the Tertiary sandstone, or sometimes in other harder rocks, as for instance, in the valley of the Ili River. Sometimes typical *barkhans* are met with among dunes, being a secondary formation arising out of the marine dunes. As to the plantations of trees on dunes, M. Moushketoff thinks that it would be far more rational first to determine whence the sand is brought by the wind, and to make the plantations of trees or bushes, according to the chemical character of the sand on this place, instead of making them on the dunes themselves.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

MANCHESTER.—We learn that the Council of the Owens College proposes shortly to establish an independent Chair of Applied Mathematics.

EDINBURGH.—The tercentenary of the University of Edinburgh will be celebrated in 1883. The senatus are to invite representatives from other universities to be present; they also propose to bring out a history of the University during the first 300 years.

THE winter session of the College of Agriculture, Downton, Salisbury, was brought to a close on Wednesday, when the prizes were presented by Earl Nelson, who dwelt at considerable length on the present state and future prospects of British agriculture, taking a very hopeful view of the latter. The High Sheriff of Wilts warmly advocated such a combination of science with practice as was in vogue at the College. The Scholarship offered for competition amongst students who have completed their first year at the College was awarded to Mr. Louis Johnstone, son of Sir Harcourt Johnstone, Bart., Hockurss Hall, Scarborough, the Hon. Victor A. N. Hood *proxime accessit*.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, March 31.—"Permanent Molecular Torsion of Conducting Wires produced by the Passage of an Electric Current," by Prof. D. E. Hughes, F.R.S.

In a paper on "Molecular Electro-Magnetic Induction," presented to the Royal Society (March 7, 1881, I gave a description of the induction currents produced by the torsion of an iron wire, and the method by which they are rendered evident. The electro-magnetic induction-balance there described is so remarkably sensitive to the slightest internal strain in anywise submitted to it, that I at once perceived that the instrument could not only determine any mechanical strain such as torsion or longitudinal stress, but that it might indicate the nature and cause of internal strains. Upon putting the question to it, Does the passage of electricity through a wire produce a change in its structure? the answer came, It does, and that to a very considerable extent; for an iron wire adjusted to perfect zero, and which would remain free from any strain for days, becomes instantaneously changed by the first passage of a current from a single cell of a Daniell's battery, the wire has now a permanent twist in a direction coinciding with that of the current, which can be brought again to zero by mechanically untwisting the wire, or undoing that which the passage of electricity has caused. Before describing the new phenomenon, I will state that the only modification required in the apparatus is a switch or key by means of which the telephone upon the wire circuit is thrown out of this circuit, and the current from a separate battery of two bichromate cells passed through the wire alone, at the same time, care being taken that no current passes through the coil, but that its circuit should remain open during the passage of the electric current through the wire under observation, an extra switch on this circuit provides for this The reason for not allowing two currents to react upon each other, is to avoid errors of observation which may be due to this cause alone. When, however, we take an observation, the battery is upon the coil and the telephone upon the wire alone An experiment thus consists of two operations First all external communications interrupted, and an electric current passed through the wire; and, second, the electric currrent taken off the wire, and all ordinary communications restored As this is done rapidly by means of the switches, very quick observations can be made, or if desired the effects of both currents can be observed at the same instant

Now if I place upon the stress bridge a soft iron wire ½ millim. diameter, 25 centims long, I find, if no previous strain existed in the wire, a perfect zero, and I can make it so either by turning it slightly backwards or forwards, or by heating the wire to a red heat If I now give a torsion of this wire, I find that its maximum value is with 40° torsion, and that this torsion represents or produces electric currents whose value in sonometric degrees is 50, each degree of torsion up to 40 produces a regular increase, so that once knowing the value of any wire, we can predict from any sonometric readings the value in torsion, or the amount of torsion in the opposite direction it would require to produce a perfect zero.

If now I place this wire at zero, and thus knowing that it is entirely free from strain I pass an electric current through it, I find that this wire is no longer free from strain, that it now gives out induction currents of the value of 40, and although there is no longer any battery current passing through this wire that the strain is permanent, the outside coil neither increasing nor diminishing the internal strain it has received by the passage of an electric current through the wire; upon giving a torsion to the wire in one direction, I find the inductive force increase from 40 to 90, but in the other direction it is brought to zero, and the amount of torsion, some 35°, required to bring the wire again to zero represents exactly the twist or strain that had been produced instantaneously by the passage of an electric current If I repeat the experiment, but reverse the battery current sent through the wire, I find an opposite twist of exactly the same value as previously, and that it now requires an opposite torsion to again bring the wire to zero. It is not necessary however to put on an equal opposite torsion on wire to bring the currents to zero, for as I have shown in my late paper, the sonometer not only allows us to measure the force and indicate its direction, but allows us to oppose an equal electric current of opposite name, thus producing an electrical zero in place of the mechanical one produced by torsion.

Evidently here there has been a sudden change in the structure of the wire, and it is a twist which we can both measure and reproduce. The question at once becomes, Has a molar twist been given to the wire such as would be detected by the arm or free end of the wire, or a molecular change leaving no trace upon its external form of what has passed?

It will be found that, notwithstanding that it requires some 40° of torsion to annul the effects of a passage of an electric current, no visible movement nor any tendency of the free end to turn in the direction of the twist it has received can be observed. I believe however to have noticed a slight tremor or movement of half a degree, but as I could not always reproduce it, and as it is so slight compared with the 40° of internal twist, I have not taken it into account, for if the wire is firmly fastened at both ends no molar torsion being possible, except an elastic one, which would instantly spring back to zero, the current on passing produces its full effects of twist and it is permanent. Thus the molecules have in some extraordinary way rearranged themselves into a permanent twist, without the slightest external indication of so great a change having taken place. An equally remarkable change takes place in aid of, or against (according to direction of current) an elastic permanent strain. Thus, if I first put the wire under 40° right handed permanent torsion, I find its value to be 50. Now, passing the positive of battery through its free end, and negative to fixed end, the induction currents rise at once in value to 90; if, now, the negative is momentarily passed through the free end and positive to fixed end the induced currents at once fall to 10, and these effects remain, for on taking off the elastic torsion the wire no longer comes to zero, but has the full twist value produced by the current

Tempered steel gave only one or two degrees against fifty for soft iron, but supposing this might be due to its molecular rigidity, I carefully brought the wire to zero, and then observed the first contact only I found then that the first contact gave a value of 40, but the second and following only one or two By bringing the wire back to zero by a momentary touch with a magnet a continued force of 40, or if constant reversals were used instead of a simple contact, there was constant proof of a similar great molecular change by the passage of a current in steel as well as iron

I can find no trace of the reaction of the wire upon the magnetism of the earth, as in all positions the same degree of force was obtained, if great care is taken that the wire is absolutely free from longitudinal magnetism, there is however a slight reaction upon its own return wire if brought within 1 centim distance of the wire, and this reduces the twist some 10° The maximum effects are obtained when the return wire is not nearer than 25 centims, thus the action is not one produced by a reaction, but by direct action upon its internal structure.

Copper and silver wires so far show no trace of the action I believe, however, that a similar strain takes place in all conductors, and I have obtained indirectly indications of this fact; in order, however, to verify this, would require a different method of observation from the one I have described, and I have not yet perfected the apparatus required.

It seemed probable that if I approached a strong permanent magnet to the wire, I should perceive a twist similar to that produced by the passage of a current, but no such effects were observed But it has a most remarkable effect of instantly bringing to zero a strain produced by the current, and, no matter which pole, the effect was the same. Thus, a strain of 50°, which remains a constant, instantly disappears upon the production of longitudinal magnetism, and I have found this method of reducing an iron wire to zero of strain far more effective than any other method yet tried, such as vibrations, heat, twisting, &c.

It will be seen from this that the molecular arrangement set up by magnetism is very different from that produced by the passage of an electric current. It evidently has a structure of its own, else it would not have instantly destroyed the spiral strain left by the passage of electricity if it had not taken up a new form, as rendered evident in the longitudinal magnetism, which we could at once perceive on the wire. This question, however, belongs to a separate investigation, and I hope the apparatus will aid me later in throwing some new light upon this subject

Another method of reducing the wire to zero, after the passage of a current, is to keep the wire in a constant state of vibration. It requires in time about one minute to bring it to zero, but if, on the contrary, I set the wire vibrating during the passage of the current, the permanent twist becomes greater and more difficult to reduce to zero

If a wire which has internal strains is heated to redness, these strains almost entirely disappear, and I can thus reduce by heat a strain which a current had produced, but heat, whilst allowing of greater freedom and motion of its molecules, does not prevent an internal strain being set up, for whilst heat can reduce the wire to zero, after the passage of the current, the effects are increased. If, during the time that the wire is at a red heat, the

current is passed in the same time, and at the same instant we take off the current and the external heat, the wire when cold will be found to have a higher degree of strain than previously possible with the wire when cold

We have seen that both mechanical vibrations and heat can reduce the wire to a zero, but its action is very slow, several minutes being required, but the action of electricity in producing a permanent twist is exceedingly quick I have found that a single contact, whose duration was not more than 0·01 of a second, was equal to that of a prolonged contact of several minutes, and magnetism was equally as quick in reducing this strain to zero And it is the more remarkable when we consider the very great mechanical force required by torsion of the wire to untwist the strain produced in an instant of time by electricity

The results I have given are those obtained upon soft iron wires of ½ millim, but I have experimented with different sizes up to 3 millims diameter. The results with 1 millim diameter were quite as evident as the ½ millim, but on the 3 millim wire the strain was reduced to 25° instead of 50°, owing to the extreme rapidity and low electrical resistance compared with my small battery wires. On a telegraph line, the wire of which is almost entirely of iron, there must be a very great strain set up, which however would remain a constant, except where reversed currents are used, and in this case a constant movement of the molecules of the wire must be the result

I believe it to be most important that we should determine, as far as we can by experimental research, the nature of all molecular changes produced by electricity and magnetism, and in this belief I am happy in being able to bring this paper before the Royal Society

Chemical Society, April 7—Dr Russell in the chair—The following papers were read—On the organic matter in sea-water, by W. Jago. The author concludes that the organic matter of sea-water is much more capable of resisting oxidising agents than that present in ordinary fresh water, and that it is probably organised and alive.—On the action of compounds inimical to bacterial life, by W. M Hamlet. The cultivating fluids used comprised Pasteur's fluid, beef tea, hay infusion, urine, brewer's wort, and extract of meat, these were sterilised by boiling for ten minutes in Pasteur's flask, cooled with suitable precautions, and then seeded with hay solution, and the substance under examination added. Many gases, &c, were tried. Chlorine and hydric peroxide were fatal to bacteria, while chloroform, creosote, carbolic acid, salicylic acid, &c, hindered their development, but did not destroy them

Anthropological Institute, March 22—F W. Rudler, F.G S, vice-president, in the chair.—The election of George B. Waterhouse was announced.—Mr. R W. Felkin exhibited a series of photographs of scenes and natives of Central Africa, taken by Herr Buchta—Prof. Flower, F R S, exhibited a collection of crania from the Island of Mallicollo in the New Hebrides, which had been lately presented to the Museum of the Royal College of Surgeons by Mr Luther Holden. The peculiar conformation of the heads of the people of this island attracted the attention of Capt Cook and the naturalist Forster, who accompanied the great navigator on his second voyage, and who writes that "the depressed and backward inclining forehead causes an appearance in the looks and countenances of the natives similar to those of monkeys." Yet Cook bears testimony to the activity, intelligence, and honesty of this "ape-like nation," as he calls them. A few years ago Mr. Busk described some skulls collected in the island by the late Commodore Goodenough, and found that they all showed signs of having undergone alterations in form from pressure applied in infancy The present collection corroborates Mr Busk's views, some of the skulls being deformed to a remarkable degree, and closely resembling the well-known Peruvian crania from the neighbourhood of Lake Titicaca. This is the more remarkable, as on no other of the numerous islands of the neighbouring ocean is the practice known to exist. Besides the deformed crania the collection contained several monumental heads, said to be those of chiefs. In these the features are modelled in clay upon the skull, apparently with the intention of preserving a likeness of the dead person; the face is painted over with red ochre, artificial eyes introduced, and the hair elaborately dressed and ornamented with feathers. In one case the hair had been entirely removed, and a very neatly-made wig substituted. The head thus prepared is stuck upon a rudely-made figure of split bamboo and clay, and set up in the village temple, with the weapons and small personal effects of the deceased This is a custom not hitherto known to exist among the Mallicollese, and its motive is not completely understood, but it is obviously analogous to many others which have prevailed throughout all historical times and in many nations, manifesting itself, among other forms, in the mummified bodies of the Ancient Egyptians and the marble busts over the mouldering bones in Westminster Abbey.—Mr. Joseph Lucas read a paper on the ethnological bearings of the terms Gipsy, Zingaro, Rom, &c.

Zoological Society, April 5—Prof W. H Flower, LL D, F.R.S., president, in the chair—Mr. Sclater exhibited five bird's skins obtained by the Rev. G. Brown, C.M.Z S., on the Island of Rotumeh, and presented by him to the *Challenger* Expedition Mr Sclater also exhibited specimens of two new species of birds from New Britain, belonging to the Museum Godeffroi, which he proposed to call *Trichoglossus rufigularis* and *Ortygocichla rubiginosa*—Mr H. E Dresser exhibited and made remarks on a specimen of *Saxicola deserti* killed in Scotland, and a specimen of *Picus pubescens* believed to have been killed in Normandy—Mr W A Forbes, F Z.S., read some notes on the external characters and anatomy of the Californian Sea Lion (*Otaria gillespii*), and exhibited some coloured drawings of this animal—Prof Flower, F R.S, read a note upon the habits of the Manatee, chiefly in reference to the question as to whether this animal had the power of voluntarily leaving the water for the purpose of feeding on the herbage of the banks, as stated by many authors, and as supported by a communication from the late Mr R. B Dobree, notwithstanding which Prof. Flower considered the evidence upon which the statement was based to be very unsatisfactory—A paper was read upon the same animal by Miss Agnes Crane, consisting of observations upon the Manatees lately living in the Brighton Aquarium.—Dr A Gunther, F R S, read an account of the Amphisbænians and Ophidians collected by Prof. Bayley Balfour in the Island of Socotra A new form of snakes allied to *Tachymenis* was named *Ditypophis vivax*, a new species of *Zamenis* was named *Z. Socotræ*, and a new form of Amphisbænian *Pachycalamus brevis*—Mr W T. Blanford, F R S, gave an account of six species of lizards which had been collected by Prof Bayley Balfour in Socotra, of these the three following appeared to be undescribed:—*Hemidactylus homœolepis*, *Pristurus insignis*, and *Eremias Balfouri*—Mr Charles O Waterhouse read a paper on the coleopterous insects which had been collected by Prof. Bayley Balfour in Socotra The number of species of which examples were collected was twenty-four, and showed that the fauna of Socotra, judging from this collection, was distinctly African. Twelve of the species appeared to be new—A communication was read from Prof J. O. Westwood containing observations on two species of Indian butterflies, *Papilio castor* and *P pollux*.—A communication was read from Mr Edgar A Smith, containing some observations on the shells belonging to the genus *Gouldia* of C. B Adams—Mr. Sclater read the fifth of his series of notes on the birds of the vicinity of Lima, Peru, with remarks on their habits by Prof. Nation, C M Z S A new species of *Buarremon*, of which an example was in the collection, was proposed to be dedicated to its discoverer as *B. Nationi*—Mr. G E Dobson read some notes on certain points in the muscular anatomy of the Green Monkey, *Cercopithecus callithrix*

EDINBURGH

Royal Society, March 21—Sir Wyville Thomson, vice-president, in the chair—Prof Geikie communicated a paper by Mr C. A. Stevenson, B Sc, on the earthquake of November 28, 1880, in Scotland and Ireland The main conclusions at which the author arrived were the following:—The centre of the disturbance was at a point some thirteen miles south-west of Fladda, in the continuation of the line of the fault that lies along the great glen which stretches in a south-westerly direction from Inverness. The disturbance was felt over an area of 19,000 square miles, extending as far east as Blair Athole, as far north as the Butt of Lewis, and as far south as Armagh in Ireland The undulation was everywhere of an up-and-down character; its breadth was estimated at 1100 feet, and its velocity seemed to vary from 3·75 to 7·75 miles per minute, having a mean value of 6·75 over the sea and 4·68 over the land. The accompanying rumbling was not heard at all the stations, and appeared to have been best heard where but little soil covered the hard dense substratum of rock. The disturbance was felt better over the older rocks Noises were not heard outside a radius of 38 miles from the centre, except in the north of Ireland, where however it was

suggested that the noise was due to the indirect action of the earthquake in causing a secondary local disturbance —Mr P Geddes read his first communication on the classification of statistics. After pointing out the utter confusion that exists in many of the national classifications of the present time, the author criticised the arrangements suggested by Deloche and Mouat, which were equally unsatisfactory, because of their unscientific and artificial methods. Any classification, to be natural, must be based upon some broad principle common to all kinds of communities or societies A fundamental meaning must therefore be attached to the word society—a definition given to it that will include societies of all kinds of organisms Such a definition must obviously take account of the vital functions of organisms in relation to the matter and energy of the universe. We have thus matter and energy on the one hand, organisms on the other Mr. Geddes, confining himself meanwhile to the first of these two great divisions, proceeded to classify the sources of energy, adopting the classification given by Prof. Tait in his Thermodynamics, and showing how naturally such things as food, fuel, machines, &c, fell into their places in such an arrangement He then considered the classification of sources of matter used for other than energy-properties, taking for this purpose the well-known three-fold division into minerals, vegetables, and animals The development of ultimate products through their successive phases of raw material, manufacture, exportation, trade, &c, and the classification of all products under the three chief headings of potential, mediate, and ultimate, completed the one aspect of the statistical method in so far as it related to the matter and energy of the universe. It still remained however to take account of the loss, or more properly the degradation or dissipation, suffered. The classification must indicate not only the kind of loss, *e.g.* whether in raw material, in manufacture, in trade, in ultimate product, or in remedial effort, but also the agency that was the direct cause of the loss, whether physical, as earthquake, flood, storm, &c, or biological, as insects, fungi, &c., or social, as crime, war, or folly —Mr. T Muir communicated three mathematical notes on Prof Cayley's theorem regarding a bordered skew determinant, on the law of extensible minors in determinants, and on a problem of arrangement —Mr. J Y Buchanan read a short paper on the oxidation of ferrous salts —Prof Tait made a brief communication on some space loci.

PARIS

Academy of Sciences, April 4.—M Wurtz in the chair —M de Quatrefages presented an example of the Edwards Medal —The following papers were read —On micrometric measurements during the transit of Venus of 8 December, 1874, by M Puiseux These measurements (393 in number and in five categories) at St Paul and Pekin fairly agree, though the conditions were unfavourable, and give for the parallax 9″ 05 —On the same subject, by M Mouchez He considers the method is to be strongly recommended for 1882.—Note on the methods of Wronski, by M. Villarceau —On photographic photometry and its application to study of the comparative radiating powers of the sun and of stars, by M Janssen A shutter with triangular aperture is made to pass with uniform motion of known rate before a sensitised plate, this gives (with light) a series of shades on the plate, decreasing from the base side to the apex side To compare the sensibility of two plates, differently prepared, or the photogenic intensity of two sources (using two like plates) the points of equal shade on the plates are noted. (The photographic intensity does not increase as rapidly as the luminous intensity) For the sun he finds the time of action (with gelatine bromide of silver plates) must be reduced to $\frac{1}{3000}$ sec to give the most rapid variation in the opacity The sides of the slit are curved (for a special reason). A series of circular images of stars are obtained by putting the plate a little out of focus.—On alcoholate of chloral, by M Berthelot —On lightning flashes without thunder, by M. d'Abbadie He observed such quite near, in a fog, when in Ethiopia —On the combinations of phtalic anhydride with hydrocarbons of the benzene series, by MM Friedel and Crafts.—Note on chalcomenite, a new mineral species (selenite of copper), by MM. des Cloizeaux and Damour. This is from near Mendoza in the Argentine Republic —Researches on changes of state near the critical point of temperature, by MM. Cailletet and Hautefeuille. By colouring carbonic acid the liquid is rendered always visible. It is found that Andrews's undulatory striæ dissolve blue oil of galbanum, so that they are produced by streaks of liquefied carbonic acid. Neither in disappearance of a meniscus through compression, nor in change of state at the critical temperature does matter pass by insensible degrees from the liquid to the gaseous state.—Magnetic anomaly of meteoric iron of Santa Catharina, by Prof. Lawrence Smith. Small fragments are very feebly affected by a magnet till they have been flattened on a steel surface with a steel hammer, or heated red hot —Attenuation of effects of virulent inoculations by use of small quantities of virus, by M. Chauveau.—M. Jordan was elected Member in Geometry in room of the late M Chasles —On the winter egg of phylloxera, by M. Lichtenstein.—Researches on the causes which enable the vine to resist phylloxera in sandy soils, by M. Saint-André Weak capillary capacity of a soil seems to be the direct or indirect cause of the resistance of vines —On the bismuthine produced by coal mines on fire, by M. Mayençon —On functions proceeding from Gauss's equation, by M Halphen —On a new application and some important properties of Fuchsian functions, by M Poincaré —On the relations between solar spots and magnetic variations, by M Wolf. Tables for 1880 are given The solar curve is also shown to be quickly rising again ; a maximum may be expected in 1882 to 1883. The increase of magnetic declination for 1879-80 is 1′ 18 by formula, 0′ 99 by observation —On the viscosity of gases, by Mr Crookes.—Luminous intensity of radiations emitted by incandescent platinum, by M Violle. From observations ranging from 775° to 1775° he constructs a formula.—On the change of volume accompanying the galvanic deposit of a metal, by M Bouty It is always possible in electrolysis of the same salt to diminish the intensity of current below a certain limit such that the compression produced by the deposit is then changed into attraction (the metal dilating instead of contracting in solidifying) —On the voltaic conductivity of heated gases, by M Blondlot He describes an experiment made by way of putting the conductivity of gases beyond doubt, and in which all parts of the apparatus are constantly open to inspection —On the internal discharges of electric condensers, by M. Villari. The laws of the phenomenon are enunciated.—On magical mirrors, by M Laurent. A common silvered mirror of any thickness may be rendered magical by means of heat, *e.g.* applying the end of a heated brass tube to it. The section of the tube is imaged.—On hydrosulphite of soda, by M. Schutzenberger —On some new processes of desulphuration of alkaline solutions, by M Scheurer-Kestner —On application of the crystals of lead chambers, by M Sulliot For disinfection of rooms he places in them porous vessels containing nitrous sulphuric acid, and to attenuate the irritating action of the vapours the vessel is placed in another containing ethylic alcohol In another case odorous gases are drawn through a column of coke moistened with nitrous sulphuric acid —On secondary and tertiary amylamines from the active amylic alcohol of fermentation, by Mr Plimpton —Action of perchloride of phosphorus on isobutylic aldehyde, by M Œconomidès.—Preparation of isobutylic acetal, by the same —On the products of distillation of colophony, by M Renard —Artificial reproduction of diabases, dolerites, and meteorites of ophitic structure, by MM Fouqué and Levy —On the Devonian formation of Diou (Allier) and Gilly (Saône-et-Loire), by M. Jullien

CONTENTS

THURSDAY, APRIL 21, 1881

SIR WILLIAM HERSCHEL[1]

III.

IN the concluding chapter of his Memoir Prof. Holden presents a Review of the scientific labours of William Herschel designed to enable the general reader to follow the course of his work and discoveries, astronomical and physical, referring to the *Analyse de la Vie et des Travaux de Sir William Herschel*, published by Arago in 1842 for a more detailed and precise account suited to the professional astronomer, also to "A Subject-Index and a Synopsis of the Scientific Writings of Sir William Herschel," prepared by himself and Dr Hastings, and forming one of the publications of the Smithsonian Institution

Prof. Holden naturally commences his review with the improvements in optical instruments and apparatus effected by Herschel Up to his time the principal aids to observation were the Newtonian telescopes of Short and the small achromatics of Dollond, the six-foot Newtonians of the former maker, aperture 9 4 inches, and the forty-six-inch achromatics of Dollond, aperture 3 6 inches, were much esteemed, and one of each class was in use at the Royal Observatory, Greenwich, in 1765 Herschel gives us some account of the progress of his manufacture of telescopes in his description of the forty-feet reflector presented to the Royal Society in 1795 When he resided at Bath, he tells us, he had long been acquainted with the theory of optics and mechanics, and wanted only that experience so essential in the practice of these sciences This he gradually acquired by way of amusement in his leisure hours (we have seen that he was closely occupied in his profession as a teacher of music), and thus he made "several two-foot, five-foot, seven-foot, ten-foot, and twenty-foot Newtonian telescopes, besides others, of the Gregorian form of eight, twelve, and eighteen inches, and two, three, five, and ten feet focal length," in all, as already stated, he made not less than 200 seven-feet, 100 ten-feet, and about 80 twenty-feet mirrors, in addition to the Gregorian telescopes The number of stands he invented for these instruments he states it would not be easy to assign Proceeding further, as early as 1781 he had designed and commenced the construction of what he terms "a 30-feet aerial reflector," and invented and executed a stand for it; he cast the mirror, "which was moulded up so as to come out 36 inches in diameter," but "the composition of the metal being a little too brittle, it cracked in the cooling." It was cast a second time, but here the furnace gave way and the metal ran into the fire These accidents and the discovery of Uranus, which introduced Herschel to the patronage of the king, put a temporary stop to the construction of a great telescope In 1783 he finished "a very good twenty-feet reflector with a large aperture," and after two years observation with it, became so convinced of the advantages of such apertures, that he recurred to his previous intention of increasing them still further. Soon afterwards, by the representations of Sir Joseph Banks, president of the Royal Society, Herschel, as his sister relates, obtained "the promise that 2000*l* would be granted for enabling him to make himself an instrument."

The forty-feet reflector, the *chef d'œuvre* of Herschel's optical and mechanical efforts, was commenced about the latter end of 1785, and, as Prof Holden remarks, the history of the instrument extends from this date until the year 1811 The work was carried on assiduously with no further interruption than was occasioned by the removal from Clay Hall to Slough, where, soon after arrival, Herschel began to lay the foundation of the whole structure, and the highly-polished speculum was put into the tube, and the first view through it was obtained on February 19, 1787. But he dates the completion of the instrument from a much later period, for the first speculum came out thinner than was intended, and from its weakness did not permit of a good figure being given to it, a second mirror, cast in January, 1788, cracked in cooling, but in the next month it was re-cast and proved of the proper degree of strength In October following a pretty good figure and polish had been assured, and Herschel says he observed the planet Saturn with it, he continued to work upon it till August 27, 1789, when upon trial on the fixed stars it gave a pretty sharp image, and on the following night he records, "Having brought the telescope to the parallel of Saturn, I discovered a *sixth* satellite of that planet, and also saw the spots upon Saturn, better than I had ever seen them before so that I may date the finishing of the forty-feet telescope from that time" The diameter of the polished surface of the great mirror was 48 inches In proof of the efficiency of the mechanism for giving horizontal and vertical motions to so large an instrument he mentions that in the year 1789 he had many times taken up Saturn two or three hours before meridian passage and kept the planet in view with the greatest facility till two or three hours after the passage On the 17th of September a *seventh* satellite of Saturn, the minute object now called *Mimas*, was discovered with the forty-feet telescope, and though the instrument was used for various purposes till 1811, these discoveries of satellites constitute its most prominent additions to our knowledge. Sir John Herschel has stated that the entire cost of construction, including the apparatus for casting, grinding, and figuring the mirrors, of which two were constructed, amounted to 4000*l*, which sum was provided by King George III His father observed the great nebula of Orion with the forty-feet telescope on January 19, 1811, and this was one of his latest observations. In 1839 the wood-work had so far decayed as to be dangerous, and Sir John Herschel pulled it down, but piers were erected upon which the tube was placed Writing in March, 1847, he remarks that it was so well preserved that "although not more than one-twentieth of an inch thick, when in the horizontal position it sustained within it all my family, and continues to sustain inclosed within it, to this day, not only the heavier of the two reflectors, but also all the more important portions of the machinery."

As Prof. Holden remarks, and a similar opinion has been expressed previously, it is probable that the general public expected more from the forty-feet telescope than it actually performed; but Herschel gave valid reasons why he did not make more extended use of the instrument: the time required to get it into proper working order and

[1] Continued from p 455

the number of assistants necessary were impediments in the way of its being utilised for regular observation, and he assures us he "made it a rule never to employ a larger telescope when a smaller will answer the purpose." It is certain that the mirror which was in the tube in October, 1789, the month following that in which Herschel dates the completion of the telescope, was of excellent definition. On the 16th of that month he followed the sixth and seventh satellites (*Enceladus* and *Mimas*) up to the limb of the planet, and witnessed their occultation. Holden writes "I have never seen so good definition, telescopic and atmospheric, as he must have had on these occasions"

Between the years 1796 and 1799 Herschel made an elaborate classification of stars visible to the naked eye according to their comparative brightness, which he communicated to the Royal Society in four papers published in the *Phil Trans* It formed the first general catalogue of the kind, exhibiting the exact state of the sky in his time A reduction of Herschel's observations was undertaken by Mr C S Peirce, and the results appear in vol ix of the *Annals* of the Observatory of Harvard College So far as we know, their reduction had not been previously attempted Instances of variability in the light of naked-eye stars were detected during the progress of the classification, the most notable discovery in this direction being perhaps that of the periodical fluctuations of α Herculis, in about sixty days Another star in the same constellation he considered had totally disappeared in 1791, though he had seen it distinctly in 1781 and 1782

Herschel was led to his numerous discoveries of double stars by his expectation of being able to determine the parallaxes of stars from measures made at opposite seasons of the year of the distances of pairs which appeared near together, and in the search for such pairs, his first catalogue of upwards of 200 double stars was formed and presented to the Royal Society in 1782 Long had previously measured stars upon a similar plan without success, but Herschel pointed out that his stars were not well chosen

For the successful application of the method it is necessary that one of the pair of stars should really be situated at a much greater distance from us than the other, and as the most reasonable test of distance, Herschel assumed their difference of brightness, so that he sought for pairs where the components differed widely in this respect The view therefore which he adopted at this time with respect to two stars seen in close proximity to each other was that one was in nearly the same line of sight as the other, but might be far more distant, thus constituting together what we now term an *optical* double star. From this beginning he was led to the discovery of revolving double stars, stars changing their relative position from year to year; and in 1803 he communicated to the Royal Society his memorable paper "An account of the changes which have happened during the last twenty-five years in the relative situation of double stars, with an investigation of the cause to which they are owing." He was then satisfied that there were in the heavens pairs of stars which were physically connected with each other. The research for stellar parallax was not successful, but in place of it he discovered the existence of binary systems. He could not in his day decide whether the motions of suns round suns was obedient to the laws of gravitation, but five years after his death the French astronomer Savary proved that one of these revolving double stars, discovered by Herschel, ξ in Ursa Major, really was subservient to that law, and as every student of astronomy will be aware, the number of physically connected systems where the elements of the orbits have been determined, is now a large one, and is gradually increasing.

Following at present the order in which Prof. Holden refers to the scientific labours of Herschel, we now arrive at his researches on planets and satellites, respecting which the improvements he made in the construction of telescopes enabled him to advance knowledge so greatly. He was not particularly occupied with the inferior planets, but he determined the time of axial rotation of Mars with greater precision than before, and also the position of his axis The times of the rotation of the satellites of Jupiter were found from observations on their changeable brightness, and Herschel also remarked the as yet imperfectly explained phenomena attending the transits of the satellites across the disk of the planet Saturn, as Holden remarks, was the object of his constant attention, in addition to the discovery of the interior satellites *Enceladus* and *Mimas*, he left upon record an extensive series of observations of the seven attendants upon Saturn at that time known, and determined the time of rotation of the outer satellite *Japetus* upon its axis, by similar observations to those made upon the satellites of Jupiter He ascertained the time of axial rotation of Saturn, and was the first who had succeeded in effecting this in a reliable manner He also remarked the curious square-shouldered appearance which the globe of the planet has been suspected to present, and of which we still occasionally hear, though it was long ago proved by Bessel to be an illusion. It is remarkable that notwithstanding Herschel's frequent scrutiny of the planet, with all his experience of observation and the advantages of optical means surpassing by far those of his contemporaries, he does not appear to have at any time suspected the existence of the interior obscure ring He proved beyond doubt that *Uranus* was attended by two satellites, and believed he had observed four others, and for a long time on his authority the planet was credited with six attendants.

In 1795 Herschel communicated to the Royal Society a memoir upon the nature and construction of the sun and fixed stars As to the former he adopted a modified view of the theory which had been advanced by his friend Wilson of Glasgow; he regarded the sun as consisting of three essentially different parts: a solid and non-luminous nucleus, cool and perhaps capable of habitation, above it the atmosphere proper, and still higher the clouds or bodies which cause the sun's intense brilliancy. In this paper occurs a remark which, as Prof Holden observes, has often been brought to bear, in consideration of the causes which maintain the solar light and heat. "Perhaps," he says, "the many telescopic comets may restore to the sun what is lost by the emission of light." We know that however credible in his day points in his theory have given way under our greatly advanced knowledge.

One of the discoveries, or perhaps we should rather say

demonstrations, which especially mark his powers of research and reasoning, was that of the motion of the sun and solar system in space and the direction of this translation, which, considered generally, has received confirmation from more recent and refined investigation Maskelyne had determined the proper motions of a limited number of the brighter stars, and Lambert, Mayer, and Bradley had thrown out ideas upon the subject, and, following up their suggestions, he showed that the sun was really in motion towards a point in the constellation Hercules, and assigned "the apex of solar motion" with what Holden considers an astonishing degree of accuracy His second paper on this subject (1805) his biographer views as "the best example that can possibly be given of his marvellous skill in reaching the heart of a matter, and it may be the one in which his philosophical powers appear in their highest exercise."

To gain a knowledge of the "Construction of the Heavens," as Herschel termed it, of the laws of distribution of the stars generally, the star-clusters and nebulæ in space, was confessedly a main object of his astronomical labours, and the memoirs bearing upon this subject extend over the whole period of his scientific career For this purpose he adopted a system of *star-gauging*, which in practice consisted in pointing his 20-feet reflector towards various parts of the sky and counting the number of stars in a field of view 15′ in diameter. In this way, by methodical observation, the great differences in number of the stars in certain portions of the sky over those in other directions were reliably defined, and in extreme cases the difference was very marked, as in one mentioned by Holden, where in R.A 19h 41m, N.P D. 74° 33′, in the constellation Sagitta, the number of stars per field was found to be 588, while in R A. 16h. 10m, N.P.D 113° 4′ in Scorpio it was only 1 1—"*ein Loch im Himmel!*" In this part of his review the author briefly touches upon the views entertained by Herschel at various periods between 1784 and 1817, he considers that while at the commencement of his researches the whole subject was in utter confusion, as they progressed data for the solution of some of the most important questions were accumulated, and the results of Herschel's whole labours form the groundwork upon which future investigators must build. "He is the founder of a new branch of astronomy"

The researches for a scale of celestial measures, on light and heat, &c, on the dimensions of the stars, on the variable emission of light and heat from the sun, are briefly referred to. Herschel's observations on the spectra of the fixed stars have been, we believe, very much overlooked. In his memoir in the *Philosophical Transactions* for 1814 he mentions that in 1798 he made some experiments on the light of a few of the stars of the first magnitude, by a prism applied to the eye-glasses of his reflectors, adjustable to any angle and direction, with the following results:—The light of *Sirius* consists of red, orange, yellow, green, blue, purple, and violet; *a Orionis* contains the same colours, but the red is more intense and the orange and yellow are less copious in proportion than they are in *Sirius* *Procyon* contains all the colours, but proportionally more blue and purple than *Sirius*. *Arcturus* contains more red and orange, and less yellow in proportion than *Sirius*. *Aldebaran* contains much orange and very little yellow *a Lyræ* contains much yellow, green, blue, and purple" Holden suggests that if we were to attempt to classify these stars by Herschel's observations alone we should put *Sirius* and *Procyon* into one type of stars, which have all the colours in their spectra, *Arcturus* and *Aldebaran* would represent another group, with a deficiency of yellow and an excess of orange and red in the spectrum, *a Orionis* would form a type of those stars, with an excess of red and a deficiency of orange; and *a Lyræ* would represent a sub-group of the first class. The correspondence with Secchi's types and representatives is almost complete

There remains one other great section of Herschel's researches and discoveries, that relating to the nebulæ and clusters of stars When he commenced his observations in 1774 very few of these objects were known. Messier's catalogue of sixty-eight such objects did not appear till 1784, and they were chiefly objects found in his long-continued search for comets Lacaille contributed twenty-eight from his observations at the Cape of Good Hope. Herschel discovered more than 2500, which he distributed in classes as follows —Class I "Bright nebulæ" (288 in all); II. "Faint nebulæ" (909); III "Very faint nebulæ" (984); IV "Planetary nebulæ" (79); V "Very large nebulæ" (52), VI "Very compressed and rich clusters of stars" (42), VII "Pretty much compressed clusters" (67), VIII "Coarsely scattered clusters" (88). In addition he pointed out large spaces of the sky covered with very diffused and faint nebulosity, which do not appear to have been re-observed. Holden advises that they should be sought for with a powerful refractor, which would be less open to illusions than Herschel's reflectors, and that the instrument should be used in the way he adopted—in sweeping.

Throughout Prof. Holden's interesting memoir there is evinced the same enthusiastic admiration of Herschel and his scientific labours, and he concludes in the same strain "He was born with the faculties which fitted him for the gigantic labours which he undertook, and he had the firm basis of energy and principle which kept him steadily to his work. As a practical astronomer he remains without an equal In profound philosophy he has few superiors"

Lists of Herschel's scientific memoirs and of works bearing upon them, are appended to the volume which has formed the subject of our notice, and which, if it has a fault, is of only too limited extent to do full justice to a long life of discovery and research. We will reiterate the hope expressed by Prof Holden in his preface, as we understand it, that some member of Sir William Herschel's family may at no distant period "let the world know more of the greatest of practical astronomers" "of a great and ardent mind whose achievements are and will remain the glory of England;" and in this connection, that whatever may be found amongst his manuscripts (and as regards the drawings of the nebulæ, no less an authority than the late Prof. D'Arrest has expressed a strong hope of further publication) may at the same time be given to the astronomical public.[1]

J. R. HIND

[1] Prof Holden's work is published in London by Messrs W H Allen and Co.

BRITISH FISHES

Natural History of British Fishes: their Structure, Economic Uses, and Capture by Net and Rod. Cultivation of Fish Ponds, Fish suited for Acclimatisation, Artificial Breeding of Salmon By Frank Buckland, Inspector of Fisheries. (London Society for Promoting Christian Knowledge.)

IT would have been difficult for Mr. Buckland to produce a dull book on any question connected with the economy of our fisheries, his merit in this respect has tended, however, to lead him too much in an opposite direction. It is painful, now that we are deprived of the living presence of the genial naturalist and industrious fishery inspector, to write an unkind word regarding any branch of his life's work, but of this book we are compelled to say that we would have appreciated it better had it been less "familiar" and more scientific That it should be full of interesting information about fishery matters was quite to be expected from the richness of the stores which its author always had at his command, and if Mr Buckland had taken pains to digest the *matter* so lavishly extracted from *Land and Water*, and had likewise collated the miscellaneous information contained in the volume with care, he might then have enjoyed the satisfaction of presenting to the public a natural history of British fishes which probably would have compared satisfactorily with other good books of the kind. It is not too much to affirm that a carefully edited selection from the numerous essays contributed to the various blue-books to which the deceased gentleman was so voluminous a contributor, would have made a more interesting volume than the present work The fact is, Mr Buckland was nothing if he was not sketchy and rapid, he would not be tied down to severe statements, but preferred to give an off-hand opinion in a dashing way, no matter that he might find out within the year that what he had advanced was very far wrong In the present volume, as a glance at the plethoric title-page will show, Mr Buckland attempted too much, with the result that portions of the information conveyed are scrappy, while some of it is probably slightly imaginative books and articles written in railway trains often enough provide hard work for the reader. In a preface to his work Mr Buckland takes pains to point out how greatly we are deficient in *exact* knowledge of the habits of our sea-fish, of the times and places of their spawning, of the food they eat, and of the period at which they are able to repeat the story of their birth. Some of the many questions which are asked by Mr. Buckland we are under the impression he should himself have been well able to answer Whether cods' eggs "sink or swim" has been often discussed, and the author ought to have been able to tell us the truth in that matter; but, on turning to the account given of the cod-fish in the present book (p. 50), it seems to be singularly deficient in its details of the natural history of that animal So far as we can observe, no reference whatever is made to the theory of Sars with reference to the floating of the eggs, but a few pages relative to the personal adventures of the author are not wanting, whilst the old story of "the Logan fish-pond" is re-told with great circumstantiality Twenty-five pages of the work are devoted to the salmon (*Salmo salar*), and the essay, confused as it is, is well worthy of perusal, although it contains, as do other portions of the book, a good deal about Mr. Buckland, and recapitulates, as usual from *Land and Water*, an account of some of the big fish in "my museum" It would be a tedious process to anatomise the contents of this "Natural History of British Fishes"; taking all that is written at its true value, we set down the work as an interesting collection of miscellanea. The account given of the Loch Leven trout (*Salmo Levenensis*) is exceedingly meagre, as is likewise the descriptions of several other fresh-water fishes, notably the vendace of Loch Maben. The most suggestive part of the present work is that which is devoted to "Pisciculture" (pp. 334 to 375) Under the title of "The Cultivation of Fish Ponds," much interesting matter is given, and a good deal of information that must be new to the uninitiated is set forth. But notwithstanding the many pleas for pisciculture which have at various times been advanced, it is questionable if the cultivation of other fresh-water fish than the salmon would *pay* as a food resource A larger supply of trout would no doubt be welcome to the angler, because the trout is *the* fish of the angler *par excellence*; moreover in many places angling has now to be paid for, and lairds in Scotland who let their moors and lochs can always lease them to greater advantage when they are well stocked

OUR BOOK SHELF

Proceedings of the Aberdeenshire Agricultural Association (Fourth Annual Report, 1879-80.)

WE have here an account of the field and laboratory experiments carried out by Mr Jamieson for the Aberdeenshire Association during the year 1879 The crops experimented on were turnips and oats As before, the principal object in view was to ascertain the comparative manuring value of various phosphates in different states of aggregation We can glance at only a few points in the results

Mr Jamieson claims to have shown that a finely powdered mineral phosphate, as, for instance, powdered coprolite, is nearly equal as a manure for turnips to the same amount of phosphate applied in a soluble form as a superphosphate, while the simply powdered phosphate is of course much cheaper than the manufactured manure. There is probably no doubt that on some soils a finely powdered mineral phosphate is sufficiently soluble to produce a considerable effect on the crop, if only the phosphate is applied in sufficient quantity, so as to present a considerable surface for attack, and to Mr. Jamieson belongs the credit of giving prominence to this fact, though it was by no means unknown before his experiments There is however no reason for supposing that dissolved and undissolved phosphates have the same manurial value When large doses of each are applied the manures may appear of equal value, because while the undissolved phosphate is sufficient for the wants of the crop, the dissolved phosphate is in excess of all requirements, and is therefore wastefully employed. Mr. Jamieson applies 100 lbs [1] of phosphoric acid per acre both as dissolved and undissolved phosphate; that is to say, about 3 cwts of bone ash and 5 cwts. of bone-ash superphosphate. Such a comparison is probably quite unfair to the soluble phosphate. For the small turnip crops obtained in Mr Jamieson's experiments 2¼ cwts. of

[1] On page 15 of the appendix the amount of phosphoric acid applied per acre is stated to be 100 lbs., but on page 16 the quantity is given as 200 lbs.

superphosphate drilled with the seed would be found quite sufficient, and probably fully equal in effect to twice the quantity of phosphoric acid applied as powdered coprolite.

Phosphate of iron applied alone was found to have practically no effect on the turnip crop, and the effect of phosphate of aluminium was but little, this is pretty much as we should expect. There is apparently some mistake in the printed analysis of the phosphate of aluminium used, as it is made to contain 38.28 per cent. of lime, and only 4.76 per cent. of ferric oxide and alumina.

The analyses given of the turnip soils cannot pass without a word, the reporter is surely unaware of the absurdity which these analyses present. The soil of the unmanured plot in the five experimental fields was analysed in 1876, and again in 1879, after three turnip crops had been taken. The analyses show that on an average about 20 per cent. of the nitrogen, and about 48 per cent of the phosphoric acid in the soil had been removed during these three years, and yet the total weight of the three turnip crops grown on the five fields during this period averaged but 16 tons per acre! The only remark made by the reporter on these figures is that the soil has evidently become reduced in nitrogen, and much reduced in phosphates, the fact that either the soil sampling or the analyses must be utterly wrong seems to have altogether escaped his attention.

The experiments with oats do not call for any special remark, except to note the patience which shelled 136,000 grains by hand in order to determine the proportion of kernel to husk in the produce of the various plots.

May we suggest that in a report of field experiments the dates of sowing and of harvest should always be given, and also a description of the character of the weather during the growing period. Without such facts before us it is impossible to interpret the results of field experiments.

Proceedings of the London Mathematical Society. Vol. xi (November, 1879, to November, 1880).

THIS is a smaller volume than usual, there being fewer papers, and none of them of a great length. The pure mathematics prevails somewhat more than usual over the mixed.

Prof. Cayley contributes articles "On the Binomial Equation $x^p - 1 = 0$, Trisection and Quartisection," a theorem in spherical trigonometry, on a formula of elimination. Sir James Cockle writes "On a Binomial Biordinal and the Constants of its Complete Solution." Mr. J. W. L. Glaisher, "On a Method of obtaining the q-formula for the Sine-amplitude in Elliptic Functions", Mr. H. W. Lloyd Tanner, "Notes on a General Method of Solving Partial Differential Equations of the First Order with several Dependent Variables," and a preliminary note on a generalisation of Pfaff's Theorem, Mr. J. J. Walker, "Theorems in the Calculus of Operations", and Mr. T. R. Terry, "Notes on a Class of Definite Integrals." Papers of a geometrical nature are—Mr. J. Griffiths, on a geometrical form of Landen's theorem with regard to a hyperbolic arc, and on a class of closed curves whose arcs possess the same property as two Fagnanian arcs of an ellipse; Mr. H. Hart, on the focal conics of a bicircular quartic; Mr. H. M. Taylor, on the equation of two planes which can be drawn through two given points to touch a quartic, Rev. J. Wolstenholme, a form of the equation determining the form and directions of a conic whose equation in Cartesian co-ordinates is given. Dr. Klein of Leipsic has a short note on the transformation of elliptical functions; Mr. Greenhill applies elliptic co-ordinates and Lagrange's equations of motion to Euler's problem of two centres of force; and Mr. Routh writes on functions analogous to Laplace's functions. Lord Rayleigh's papers are on reflection of vibrations at the confines of two media between which the transition is gradual, and on the stability or instability of certain fluid motions. Mr. Samuel Roberts has two notes, one on a problem of Fibonacci's, and the other on the integral solution of $x^3 - 2Py^3 = -z^3$ or $\pm 2z^3$ in certain cases. Mr. R. F. Scott writes on cubic determinants and other determinants of higher class, and on determinants of alternate numbers (a treatment which he has adopted in his work on "Determinants"). Mr. Hugh McColl contributes a fourth paper on the calculus of equivalent statements (cf. Prof. Jevons's remarks, NATURE, vol. xxiii. p. 485). Other minor articles conclude the volume.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.

[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.]

The New Museum of Natural History

THE new Natural History Museum, opened on Easter Monday, was visited by some 16,000 people of a most orderly and respectable class. Owing to the great exertions of Dr. Woodward, whose zeal is beyond praise, the main gallery, the Pavilion, and the Gallery of Reptiles were shown in a practically completed state. The Mineral Gallery has long been ready, but the arrangement of the botanical section is still incomplete, and it was entirely closed. Some little trouble was caused with the umbrellas, and it might be worth while to consider whether, except perhaps in wet weather, the umbrellas need be taken away. The idea that people poke with sticks at objects in museums has been long exploded, and no inconvenience is felt at the Kensington Museum, the Louvre, and nearly all foreign galleries and exhibitions, where umbrellas are admitted.

The architecture in the Mammalia Gallery is very obtrusive, and its over-ornate character and the variety of tone of the terra-cotta, and the similarity of this in colour to the skulls and skeletons of the fossil mammalia, are most unfortunate.

It seems a pity that some style with more repose than "Decorated Norman" was not elected. Although very beautiful as a building, and with many features deserving high praise from an architectural point of view, it is evidently not the style best adapted to set off natural history specimens. The cathedral-like Index Museum, with its rather dark side-chapels, and the Museum of British Zoology are of proportions that will render it difficult to make an effective display in them.

I hope that it is not finally decided to place the recent mammalia on the first floor and the birds on the ground floor, because the architect's string courses would be interfered with otherwise by the cases. The living and extinct mammalia should face each other, and the birds go aloft. Convenience has already been too much sacrificed to architecture. Every time the first floor is visited the length of the Index Museum, 150 feet, must be traversed to reach the stairs, and the same distance back along the corridor to reach the door of the Mineral Gallery. This means an immense waste of time. I also notice that the crane is close to the main entrance, and that there are no proper lifts.

If it was necessary to fashion all the ornaments from natural-history objects, it is a pity that the restorations were not accurately made. The oft-repeated figure of a Dapedius wallowing a fish almost its own size, and of spiral shells bent to accommodate them to the mouldings of an arch, is not instructive. The humour of ornamenting (?) the arch leading into the pavilion with a hideously represented Archæopteryx in high relief, repeated a dozen times, is not obvious, but some joke must doubtless be intended.

The cost of the small bronze and glass conservatories in the botanical department is out of all proportion to the objects they are to contain. Dried stems of tree-ferns and palms, though very interesting in their way, do very well in other museums without glass cases, and can be replenished for next to nothing.

F. G. S.

The Tide-Predicter

MR. EDWARD ROBERTS' letter in NATURE for April 14 contains statements giving an erroneous view of the origin of the tide predicter. Any one who feels sufficient interest in the subject to derive full information will find it in my paper on "The Tide-Gauge, Tidal Harmonic Analyser, and Tide-Predicter," read before the Institution of Civil Engineers on March 1 and in the abstract of the discussion which followed it, to be published in the *Minutes of the Proceedings* of the Institution (vol. lxv sess 1880 81, part iii), and he will see that my letter in NATURE of March 31 is correct WILLIAM THOMSON

The University, Glasgow, April 16

Geological Relations of Gold in Nova Scotia

IN the notice of the report of Mr. Murray on the gold of Newfoundland (NATURE, vol xxiii. p 472) I observe a reference to my own opinion of the age of the gold of Nova Scotia which needs some correction In the second edition of "Acadian Geology" (1868) the gold-bearing series is included in the Lower Silurian, but this referred to the larger sense of that term in which it was used to include the Cambrian as well In the third edition (1878, Supplement, pp. 81, 85, 92) I have referred this formation, on the evidence of fossils and stratigraphical position, to the age of the Lower Cambrian or Longmynd series, thus placing it on a lower horizon than the fossiliferous Primordial of Eastern Newfoundland, which I suppose to be of the age of the Acadian or Menevian group. There is therefore little difference between Mr. Murray's estimate of the age of the gold-bearing rocks of Newfoundland and my own of that of the similar rocks in Nova Scotia, except that I presume he would classify the Newfoundland series as Upper Huronian rather than Lower Cambrian With reference to this I have been disposed to regard Mr. Murray's *Aspidella* slates and the associated rocks as equivalents of the Kewenian or "Upper copper-bearing group" of the West, and probably Upper Huronian, in which case they might be a little below my Nova Scotia Lower Cambrian , but the precise age of both series is determined merely by the fact that they appear to belong to the period between the Huronian proper, or Lower Huronian, and the Acadian group, or Menevian (Étage C. of Barrande)

It is proper to add that in the third edition of "Acadian Geology" I have shown that the filling of the Nova Scotia gold veins is much more recent than the containing rocks, and belongs to the time intervening between the Upper Silurian and the Lower Carboniferous, the richer deposits also appearing to be related to the occurrence of intrusive granites of Devonian age. There is no reason, therefore, other than the mineral character of the containing beds, why such veins might not occur in any rocks older than the Devonian, and gold discoveries have been reported in localities where the rocks are supposed to be Huronian and Silurian, but I have had no opportunity of personally verifying these statements. Thus far the important gold veins are known only in that great series of slates and quartzites of the Atlantic coast which I have referred to the Lower Cambrian J. W. DAWSON

McGill College, Montreal, April 4

Symbolical Logic

PROF. JEVONS, in his criticism of my method in NATURE, vol xxiii. p 485, has stated the main points at issue between us so fully and clearly, and on the whole so fairly, that I need only say a very few words in reply.

As to the charge that my method is ante-Boolian or anti-Boolian, I do not seek to repel it ; on the contrary, I maintain that my method is different from Boole's in principle, and very different indeed in its practical working. The really important questions to be settled are these ·

1. Are the definitions which I give of my symbols clear and unambiguous ?

2. Are the rules and formulæ which I derive from these definitions correct ?

3. Are the innovations which I propose of any practical utility ?

Now, I do not think that any one who has read my papers in the *Proceedings* of the London Mathematical Society and my articles in *Mind* and in the *Philosophical Magazine* will refuse to answer *Yes* to questions 1 and 2 ; and with regard to question 3 I can only say that any one who answers *No* is bound in fairness to prove the inutility of my innovations by solving one or two of my hardest problems without their aid, and in an equally clear and concise manner My proposal of an amicable contest in the *Educational Times* meant nothing more serious than this.

Some of my critics (not including Prof. Jevons however) seem anxious to magnify the points of resemblance between my method and its predecessors, especially Boole's, and to minimise the points of difference It may be as well therefore to state briefly what characteristics distinguish my method, so far as I know, from all the methods which have preceded it, and what advantages, in my opinion, accompany these characteristics.

In the first place, then, every single letter in my notation, as well as every combination of letters, denotes a *statement*. By this simble device I gain the important advantages of generality of expression and uniformity of interpretation and treatment. It enables me to express many important logical laws in simple and symmetrical formulæ, as, for instance,

$$(A : a)(B : b)(C : c) : (A + B + C : a + b + c),$$

which otherwise could not be so expressed To secure these advantages I sacrifice absolutely nothing. The relations of classes, including the ordinary syllogisms, I express by speaking throughout of *one individual*, just as mathematicians express the properties of curves, surfaces, and volumes, by speaking throughout of the varying distances *of one representative point*.

My claim to priority on this head has been called in question on the ground that Boole too, in his equations about "secondary propositions," denotes statements by single letters. The plain truth however is that Boole takes some pains to prevent his readers from imagining that he does anything of the kind He says distinctly, and in perfect consistency with the whole tenor of his book, in which he describes his algebra of logic as a mere offshoot and part of the ordinary algebra of quantity, that in his equations any single letter, such as x, denotes the *portion of time* during which some proposition x is true, the whole universe of time to which the discourse refers being the unit (see "Laws of Thought," from p 164 to p 170) Neither will one find anywhere in Boole's work the idea (suggested to me by analytical geometry) of investigating the relations of different classes, while speaking only of *one individual*, and thus dispensing entirely with the quantitative words *all*, *some*, and *none*, which are so characteristic of the old logic.

Another peculiarity of my method is that my symbol of denial (an accent) is made repeatedly to apply to expressions of varying complexity, as, for instance, $(xy)'$, $(x + y z)'$, $(x \cdot y')'$, leading to rules and formulæ of operations, to which I find no parallel in any prior symbolic system with which I am acquainted

Boole uses $\bar{x}$ as an abbreviation for $1 - x$. Let those who insist that Boole's horizontal stroke is exactly equivalent to my accent express in his notation the complex equation

$$(x = y)' = (x : y)' + (y : x)',$$

and explain its meaning clearly *without departing from Boole's quantitative interpretation of his symbols.*

Lastly, my symbol : expresses *implication* or *inference*, and does not, therefore, exactly coincide in meaning with Prof. Peirce's symbol of inclusion —<, as defined by him in his "Logic of Relatives," published in 1870. This symbol of inclusion, as I understand Prof Peirce's definition of it, is simply equivalent to the words "is not greater than," and is therefore restricted to number and quantity. It is true that Prof. Peirce in his recent memoir on the "Algebra of Logic" extends the meaning of this symbol of inclusion, so as to make it also convey the same meaning as my symbol of implication ; but as this memoir was published subsequently to my second and third papers in the *Proceedings* of the Mathematical Society, to which Prof. Peirce explicitly refers in his memoir and accompanying circular note, this later definition does not bear upon the point in discussion.

Prof. Jevons objects to my $\alpha : \beta$ as an abbreviation for $\alpha = \alpha\beta$, because he thinks it obscures the real nature of the reasoning operation. But one might with equal justice object on the same grounds to a^3 as an abbreviation for aaa, or to the left side of the equation in the binomial theorem as an abbreviation for the right side. The symbol $\alpha : \beta$ is the exact equivalent of $\alpha = \alpha\beta$, just as $\alpha = \beta$ is the exact equivalent of $(\alpha : \beta)(\beta : \alpha)$, and I do not see that I create any obscurity by adopting in any investigation, and at any stage of the investigation, whatever form seems most suitable for the immediate purpose in view. But whether I am right or wrong in this opinion can only

be decided by actual examination of my published papers on symbolical logic, of which Prof. Jevons has very kindly given in NATURE a full and complete list. HUGH MACCOLL

73, Rue Siblequin, Boulogne-sur Mer, April 7

Agricultural Communism in Greece

THE article in NATURE, vol. xxiii. p. 525, on Aryan villages and other Asiatic communities reminds me of what I saw in 1843 in the course of a journey through Greece. On St George's Day, a high festival with the Greek peasants, when crossing the range of Mount Cithæron between Thebes and Eleusis, I saw my companion, who was about half a mile ahead, surrounded by a number of men, and then pulled from his horse. The man we had engaged as interpreter, guide, and protector, the "dragoman," bolted as a matter of course, thinking we had fallen upon a nest of brigands; but when I reached the scene of action I was surprised to find that the yelling and uproar heard in the distance were not murderous nor at all malignant, but purely hilarious. I was dragged from my horse also, and surrounded by about twenty young fellows with shaven heads and long scalp locks, half stripped, half drunk, and very dirty, but perfectly good humoured.

We were presently made to join in a wild dance, a survival of the Pyrrhic dance of antiquity, which we improved very successfully; my companion, C. M. Clayton, from Delaware, doing a nigger break down and I the sailor's hornpipe.

On the final arrival of our dragoman we learned that the twenty young men were brothers, and that the old man with long white beard who sat gravely looking on and playing a sort of tom-tom to tune the dance was their father. On our expressing surprise at so large a family of sons being so nearly of the same age he explained that ἀδελφός did not always signify a blood relation, and that these were merely *agricultural* brethren. They were the united proprietors or renters (I do not remember which) of the adjoining farmhouse and the surrounding land, which they cultivated under the direction of the old man whom they had selected as their father, who was entrusted with the custody and division of their capital and profits, who arbitrated in cases of quarrels, and was otherwise obeyed in most things.

Here was a patriarchal form of communism that we afterwards met with in several other instances, but in this and the other cases it was limited to young unmarried men. There were no women in the dance and none visible on this farm, which was some miles distant from the nearest village, Platæa.

At that time the Klephts, or brigands, were united in similar communities, who sternly abjured all communication with the fair sex.

When we had finished our dance and paid for sufficient wine to go round the family circle we found that before going we must kiss all the brothers or give mortal and dangerous offence. Andrew, our dragoman, with the inventive facility of his nation, extricated us from this by solemnly stating that in England it was an established custom to show respect for a family by embracing the father only, and bowing separately to each of the sons.

I am unable to supply any further particulars concerning the internal economy of these communities, cannot say whether they prevail chiefly among the Greeks or the Albanians (the latter constitute a large proportion of the agricultural population of Greece), nor how they dissolve when the brothers become married or the father dies. I have met with no account of them in the course of my reading, but am not at all surprised at this, seeing how profound is our general ignorance of everything pertaining to Greece, an ignorance which is most glaringly displayed by political writers and others, who speak of Athens as though it were Greece, and of Athenian proceedings as though they were the action of the Greeks.

But for the accident of this rather startling festive encounter with these brethren on this particular holiday, we might have travelled for weeks without meeting any visible indications of such fraternities. We should have passed the brothers if they were working in the fields, and the patriarch had he been sitting alone at the farmhouse door, without special notice. It was only after our curiosity had been excited that we discovered other patriarchs and other brethren by special inquiry where their existence was vaguely indicated.

Among the readers of NATURE there may be some who have sufficient acquaintance with the Greek people, outside of Athens, to be able to supply interesting particulars concerning these curious communities. They may be survivals of our ancient communism, or a modern device for mutual protection forced upon the rural population by the absence of any enforcement of law and social order by those who consume the taxes in Athens.

W. MATTIEU WILLIAMS

Heat of Stellar Masses

I SEND you a working hypothesis which I think will well pay for its place in the world. It is as to the heat of large stellar masses; that the imperfect conduction of the kinetic force producing gravitation through large stellar masses causes heat in them.

The quantity of heat stored up may depend partly on the proportion of mass to radiating power, and partly, perhaps, on the condition of the mass for such conduction.

Washington, D. C., March 25 SAML. J. WALLACE

Shadows Cast by Venus

ON March 21 last, about 8 p.m., I was walking among some trees by a river's bank. The ground was covered with recently-fallen snow, and the shadows of the trees were unmistakably, *though faintly, traceable on the white surface.* The night was dark and the shadows were thrown by Venus, which was shining with unusual brilliancy. I believe this obvious form of the phenomenon is not a common one in our latitude.

CHAS. T. WHITMELL

31, Havelock Street, Sheffield, April 18

The Sparrow and Division of Labour

THE following curious fact may possibly interest your ornithological readers:—Last year and the year previous two pairs of swallows made their nests and successfully reared their broods under the eaves of my house. Within the past fortnight a brace of astute London sparrows have apparently recognised the principle of division of labour as applicable to their requirements in the art of nest-building. They have selected the largest and most substantial of the swallows' nests referred to; and, after devoting a day or two, on starting on their enterprise, to the enlargement of the entrance hole, which was probably too narrow for them, have constructed their bed within of bits of grass and feathers in the usual fashion. They are now enjoying their honeymoon in their new quarters. G. C. WALLICH

3, Christchurch Road, Roupell Park, April 11

SIR PHILIP DE MALPAS GREY EGERTON, M.P., F.R.S.

IN Sir Philip Egerton geologists have lost one of that band of workers who placed their science upon the footing which it now occupies in this country. Unfortunately that band has been of late years greatly diminished by death. Born in 1807, Sir Philip Egerton with his old friend and fellow-worker, Lord Cole (now the Earl of Enniskillen), while still at Oxford commenced the collection of fossils, and very soon their attention was especially directed to fossil fish, of which but very little was at that time known. As specimens of this group of organisms often occur in duplicate, the individuals breaking across so that two opposite slabs each contain one-half, the two friends agreed to share their spoils, and thus both collections were enriched. When in 1840 Agassiz visited this country, intent upon his great ichthyological memoirs, he found in the museums of Sir Philip Egerton and Lord Cole an abundance of materials ready to his hand. The specimens were carefully figured, and descriptions of them included in the several great works which Agassiz successively issued. The original drawings by Dinkel are now among the archives of the Geological Society. But Sir Philip Egerton was by no means merely a collector of fossils, he was a very diligent and successful student of ichthyology. Many valuable papers on fossil fishes were written by him at different times, and a series

of papers published in the decades of the Geological Survey of the United Kingdom are among the most valuable of the works issued by that body An excellent man of business, Sir Philip took an active part in the administration of the British Museum, the London University, the Geological Society, and other institutions for the promotion of science. All who knew him will miss the kindly face and cheerful manners which distinguished him. Only two days before his death he was in his place in Parliament, but a chill caught during the lately prevalent east winds proved rapidly fatal At the last meeting of the Geological Society the vice-president, Mr J Whitaker Hulke, F.R S., made announcement of his death, and the sudden and unexpected tidings concerning one who was so widely known and so universally respected cast a sad gloom over the proceedings of the evening

A correspondent sends us the following additional note on the late Sir Philip Egerton —

The knowledge of the extinct species of fishes is one of the latest additions to palæontology, and the creator of this department of the science, Louis Agassiz, found the richest materials for his great work in the British Isles In their acquisition he was greatly aided by Lord Cole, now Earl of Enniskillen, and by Sir Philip de Malpas Grey Egerton, Bart, M P Their gatherings resulted in most complete collections of fossil fishes, and science is much indebted to the catalogues drawn up and published by Sir P Egerton of that preserved at Oulton Park Besides the species named by Agassiz this collection includes many which have been subsequently determined and described by Sir P Egerton, whose name will be ever associated with that of Agassiz in palichthyology In his public career Sir Philip Egerton has been distinguished by his unremitting attention to his parliamentary duties in the long period since his election in 1830 The British Museum sustains a severe loss in a Trustee, elected in 1851, whose scientific knowledge, sound judgment, and administrative ability were of the greatest value, especially to the Natural History Departments Sir Philip's last attendance at the Board was but a few days—apparently in his usual good health—before his lamented death

THE SCIENTIFIC PRINCIPLES INVOLVED IN ELECTRIC LIGHTING

FOUR Cantor Lectures on this interesting subject have just been delivered at the Society of Arts by Prof W. Grylls Adams, F.R S , the lectures will be published in full in the *Journal* of the Society of Arts, but we are able to give an abstract of them by Prof. Adams In the first lecture, the discoveries of Œrsted, Ampère, Arago, and the early discoveries of Faraday on magnetic and current induction were considered in their relation to the principles of conservation and transformation of energy

Lecture I.—Prof Adams began by stating and illustrating the fact that important discoveries, after they are made, often pass through a stage of neglect or a stage of quiet development, then enter on the practical stage, when new facts and new inventions follow with great rapidity. The potential energy of the discoverer is transformed into energy of action in many directions with more or less efficiency, according to the retarding state of the medium through which that action takes place

Electrical science has passed through these stages, whether we regard telegraphy from the work of Sir Francis Ronalds in 1816, who said, "Let us have electrical *conversazione* offices communicating with each other all over the kingdom," down to the establishment of telephonic exchanges, or whether we consider electric lighting from the grand experiment of Sir Humphry Davy in 1813 with a battery of 2000 cells, down to the latest results obtained by means of the most recent magneto- or dynamo-electric machines

In the year 1819 Œrsted observed the action of a current of electricity on a suspended magnetic needle, and in the year 1820 Ampère studied the laws of their mutual actions, and propounded his celebrated theory of magnets and of terrestrial magnetism, making magnetism the resultant action of electric currents In the same year Arago discovered the magnetisation produced by electric currents, laying the foundation of the subject of electro-magnetism

The discoveries of Œrsted, Ampère, and Arago were fully illustrated by experiments, and their connection with one another explained In the same year, 1820, Schweigger invented the galvanometer, and in 1827 Ohm deduced his simple theory of the action of batteries from the principle of Volta

The relation of the experiments of Œrsted, Ampère, and Arago to the principle of conservation of energy was then fully considered. Considering Ampère's experiment of the motion of wires towards one another when like parallel currents are flowing in them, it was shown that the currents must be diminished whilst they are actually approaching, and increased whilst they are separating, and so by supposing one of the original currents very small, the relation between Ampère's results and the induction of a current by moving a wire in the neighbourhood of another current was deduced.

The laws of induced currents were then explained and illustrated by some of the early experiments of Faraday, who discovered the induction of electric currents by magnets in 1831

"In his first series of papers to the Royal Society entitled—(1) On the Induction of Electric Currents, (2) On the Evolution of Electricity from Magnetism, (3) On a New Electrical Condition of Matter, (4) On Arago's Magnetic Phenomena, Faraday unfolds step by step the laws of the induced current in a helix of wire B, placed near to another helix A, carrying a voltaic current

"That as long as a steady current was maintained in A there was no current induced in B, that on making contact in A or on approaching the wires there was a momentary inverse current in B, and on breaking contact in A or on separating the wires, there was a direct induced current in B That as this current was of the nature of an electric wave like the shock of a Leyden jar, it might magnetise a steel needle, although it produced slight effect on a galvanometer, and how this expectation was confirmed, and that the needle was magnetised opposite ways on making and on breaking contact" Then in his evolution of electricity from magnetism he gives an account of the greatly increased effects on introducing soft iron cores into his helices of wire, and shows that similar effects are obtained by using ordinary magnets in place of a helix carrying a battery current round an iron core, *i e*, in place of an electro-magnet He then describes the experiment of introducing a magnet into a coil of wire, and shows that the same current is obtained whether the marked end of the magnet be introduced at one end of the coil or the unmarked end introduced at the other, and that a current is produced in the opposite direction to the former on withdrawing the magnet from either end Then after describing the method of producing his induction spark and also muscular contractions of a frog by means of a loadstone and coil, and remarking that the intensity of the effect produced depends upon the rate of separation of the coil from the poles of the loadstone, he concludes this section thus. An agent which is conducted along metallic wires in the manner described, which, whilst so passing, possesses the peculiar magnetic action and force of a current of electricity, which can agitate and convulse the limbs of a frog, and which finally can produce a spark, can only be electricity.

Faraday also observed the difference of time between induction by a battery current in a coil, which is instantaneous, and induction by a magnet, which requires an interval of time to get up to its full value; and accounted for this retardation by supposing that there is a redistribution of the Amperian currents in the iron itself, so that the magnet requires time to rise to its full power

Little did Faraday dream of the rapid development and the marvellous results which were to flow from his experiments when, fifty years ago, he established the laws of magnetic and current induction, being stimulated (as he says) to investigate experimentally the inductive effects of electric currents with the view of elucidating Ampère's beautiful theory of magnetism, and in the hope of obtaining electricity from ordinary magnetism

Lecture II.—It was shown in the last lecture that a circular current or a current in a coil of wire acted as a magnet, one face of the coil, in which, as we look at it, the current appears to go contrary to the hands of a watch, corresponding to the marked pole or the pole of a magnet which points to the north, and the opposite face of the coil corresponding to that pole of the magnet which points to the south Each of the Amperian circular currents in the separate molecules of a magnet is equivalent to a fine magnet with poles of the same magnetic strength as the current, and occupying the same position, and the collection of Amperian currents will have the same magnetic effect as the bundle of small magnets, each of which gives the direction of the magnetic force at the point These separate fine magnets may be regarded as Faraday's lines of force, and the number of them issuing from a magnetic pole will be a measure of the strength of the magnet The magnetic field of the magnet is any portion of space to which the influence of the magnet extends The current which will be produced by the motion of a conducting wire in the magnetic field will be proportional to the strength of the magnetic field, *i e* proportional to the number of lines of force cut by the conductor, so that the current produced in each half turn of a coil of wire revolving on an axis is proportional to the number of lines of force cut by the coil during its rotation, so that the total current from the coil will be proportional to the number of lines of force multiplied by the number of times the wire is repeated in the coil In the case of a coil of wire rotating in the field of a magnet, if the axis of rotation is parallel to the lines of force no current is produced, but as the axis of rotation is turned more and more nearly at right angles to the lines of force the current in the coil is increased Taking the earth for our magnet, when the axis of rotation is perpendicular to the lines of force and still in the magnetic meridian, the current in that half of the coil which is moving from west to east will be from north to south, and the current in the other half of the coil which is moving from east to west will be from south to north, so that in the whole coil we get during every half turn an all-round current in one direction in the coil. The direction of the current in the coil, as we look at it from the east, is the same as the direction of rotation of the coil as we look at it from the north. The direction of the current in the coil is alternately in opposite directions for every half turn, but a continuous current may be obtained from it by reversing the connections with the ends of the coil by a commutator at the same instant as the currents are reversed in the coil

These are the principles of all magneto-electric machines The distribution of lines of force in the magnetic field of currents and of magnets is well shown by projecting some of Prof S. P. Thompson's transparencies, which show the magnetic effects resulting from the mutual action of currents and magnets on one another

After the discovery by Faraday, in 1831, of the method of producing a current of electricity by the sudden removal of a coil of wire from the pole of a magnet, the laws of these currents were being developed, but for twenty years no attempt was made to apply them for the purposes of electric lighting Voltaic batteries were being improved, and the more constant batteries of Daniell, of Grove, and of Bunsen were discovered, and these were the sources of electricity employed to produce the more powerful currents of electricity In this country forty or fifty cells of Grove have given us the electric light for optical experiments in our laboratories, and the light was kept steadily in the same position by the elaborate arrangements of wheel-work and electromagnets devised by Staite in 1847 and by Foucault, which have reached very great perfection in the hands of Duboscq In the Duboscq lamp the current passes always in the same direction, and the positive carbon becomes hollowed out, and burns away about twice as fast as the negative carbon, which becomes pointed The carbons are moved towards one another by means of a drum carrying two wheels, whose diameters are as 2 to 1, which move two racks which bring the carbons together This lamp is especially adapted for projection on a screen, and we may study the forms of the carbons by projecting them, and also study the kind of light given out by the vapours of metals burning in the arc, if we burn silver in the arc we shall see that it is rich in the violet or chemical rays, which points to the reason why the salts of silver are so much used in photography

Even with constant batteries there is great variation in the steadiness of the electric light, but much more is this the case when the current of electricity is obtained by the motion of a coil of wire in a magnetic field, for every alteration in the resistance in the circuit reacts on the machine producing the current so as to increase the disturbance Hence regulators are necessary in order to control the current, so as to keep the light constant In electric lighting regulators may act on the electric lamps themselves so as to give a steady current between the carbons by keeping them the same distance apart, or regulators may be used in another part of the circuit to control the current automatically by causing it to introdu e extra resistance when the current increases, and to diminish the resistance when the current diminishes

Various methods of regulating the current, including those employed by Siemens, Lane Fox, and Edison, were then described. In order to find the yield or effective work of batteries or magneto-electric machines and their efficiency, measurements of the current and of the work done by the current must be made

There are four principal methods of measuring electric currents.—

1. The galvanometer method, by which with a galvanometer of small resistance a very small fraction of the current is measured, and any error of observation is multiplied in estimating the total current flowing.

2 The heat method, in which the current is measured by the heat developed by the current in a given resistance in the circuit according to Joule's law, that the heat is proportional to the square of the strength of current

3 The electrometer or potentiometer method, in which the difference of potential between two points in the circuit with a given resistance between them is directly measured and the current deduced from Ohm's law.

In using Thomson's quadrant electrometer for strong currents, the needle and one pair of quadrants should be connected together, so that the deviation is then proportional to the square of the difference of potential, and this method is applicable for continuous currents and also for alternate currents. By means of two electrometers in different parts of the circuit the current and also the work done by it may be at once measured If, for instance, one of the electrometers be connected with the two carbons, the difference of potential and work done between the carbons may be determined. By such measurements it has been found that there is an electro-

motive force of 30 or even 40 volts between the carbons in the electric arc, but that the actual resistance of the arc is small

4. The electro-dynamometer method, the best method fitted for ready measurement, in which the current in one coil is attracted by the same current flowing in another coil, and the attraction is balanced by a spring as in Siemens's electro-dynamometer, or by weights as in Trowbridge's electro-dynamometer A beautifully-made instrument by Elliott and Co. was exhibited, in which the coils are thick copper bands, fixed coils being placed on each side like the coils of a tangent galvanometer, the suspended coil being placed between them in place of the magnet of the galvanometer. This instrument is especially useful for the measurement of very large currents in absolute measure.

The remainder of the second lecture was devoted to the consideration of the efficiency of batteries or of magneto-electric machines when employed as motors to do work by means of electricity, and it was shown that the greatest amount of effective work is produced when one-half the energy of the battery or current-generating machine is converted into useful work in the electric circuit. Numerous experiments were made with Clarke's and other magneto-electric machines to show that by the same machine work may be produced by sending a battery current through it, causing motion of the armature carrying the current in accordance with Ampère's laws, or a current of electricity may be generated by turning the armature, *i e* by doing work upon the machine, so that a magneto-machine is a reversible engine. A small magneto-machine with a Siemens armature was made to work a pump, or when turned by hand produced a current of electricity. Also a battery current in a Gramme ring in front of the poles of a Jamin magnet caused rotation of the ring and turned the heavy driving-wheel of the machine, and on removing the battery and turning the driving-wheel by hand, a current of electricity was produced which caused a piece of platinum wire to glow. Also a Tisley's hand dynamo-machine was employed either to heat a long piece of platinum wire or to drive another magneto-electric machine, so producing a secondary current capable of heating a considerable length of platinum wire

(*To be continued*)

THE FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AT ALGIERS

Algiers, April 14

THE number of members enrolled for the present Congress is much larger than might have been expected when we consider the length of the journey. To a Parisian member this is such as would be experienced by a Londoner if our British Association met in Gibraltar Yet more than 1500 names are on the list Few of these are familiar to us. There appear to be an unusual number of doctors and professors of anatomy and physiology, and of civil engineers. We fear we must also confess that a great many people possessing little or no interest in science, who will not be present at a single sectional meeting, have joined the Association for the sake of seeing Algiers The general character of the meeting appears to be that of a great excursion There are only five days partially devoted to work, while the banquets, balls, fêtes, courses, and "fantasias" are rapidly multiplying.

On arriving in Paris we were told that the steamer which was to have conveyed us to Algiers had been requisitioned by the Government for the transport of troops to Tunis, but the Company determined at last to take both soldiers and *savants*, and the result was of course an overcrowded boat and excessive discomfort. With accommodation for fifty first-class passengers no less than one hundred and twenty-nine were crowded into the vessel, and had the voyage been anything but of the smoothest, it would have been most wretched. As it was it was bad enough; the food was insufficient in quantity and detestable in quality, and passengers were glad to find six feet of floor to sleep upon. In Algiers itself the hotels are quite full, and the salons will be used as dormitories.

The Congress will be opened to-day by the inaugural address of M Chauveau, which is to be given in the theatre at three o'clock, after which the members will remain and resolve themselves into a general committee to discuss the creation of a sixteenth section relating to pedagogy, afterwards the secretaries of sections will meet to arrange their proceedings, and at 9 p.m. the members will be received by the Municipality at the Hotel de Ville. The general programme for the rest of the week is as follows.—

Friday, April 15—Sectional meetings in the forenoon, general meeting at 2 p m.; conference at half-past 8

Saturday—Sectional meetings in the morning, visit to the Algerian Exhibition in the afternoon; Arab *fête*, and a *soirée* given by the Municipality

Sunday—"Courses et fantasia"

Monday—Sectional meetings in the morning, a procession through the town in the afternoon, and an Arab *fête* in the evening

Tuesday—Sectional meetings, general concluding meeting, in the evening a ball given by the Governor

On *Wednesday* the excursions commence, they are both general and sectional, and the longest lasts for a fortnight.

A complete list of the papers to be read has not yet appeared, but in the list already published we do not note anything of special interest.

English science is represented by Dr G H. Gladstone and Mr Siemens, who will both read papers.

The Association has presented to each member a work in two volumes entitled "Notices scientifiques, historiques, et economiques sur l'Alger et Algérie"

April 15

The theatre was well filled yesterday afternoon to hear the address of the president, M. Chauveau, who is Professor of Physiology in the Lyons Veterinary College His discourse was of a far too technical character to be of interest to the majority of his audience, and dealt principally with the germ theory and Pasteur's theory of fermentation. It was read throughout without the least attempt at oratory, and it contained various political allusions which were much applauded In the evening the members were entertained by the Municipality, and the town was illuminated The real work of the Association commenced this morning, when the sections met at hours varying from eight to ten o'clock. We fear that the number of papers is small, and that the Association does not represent French science at all completely In the Physical Section, for example, the names of only two authors of papers appear to-day—MM. Brillouin and Crova. At 9 a.m., when the section was announced to meet, no one was present Shortly afterwards the secretary arrived, but an hour later the section had not met. The average number of the audience at the sections which had already met did not at this time exceed *ten*.

Among the more interesting papers announced for to-day are the following.—M. Marcheray, on Telephonic Communication in large towns; M. Tacchini, on the Observatories of Etna and of Chimona; M. Thoulet, on the Employment of the Microscope in Chemical and Physical Researches connected with Mineralogy; M. Prungrueber, on 300 Anthropological Observations on the Kabyles of the Djurdjura Mountains.

The Medical and Agronomical Sections have plenty of communications. The new section of Pedagogy has been established under the honorary presidency of M.

Godard, Director of the École Monge in Paris, who has brought twenty of the pupils with him. M. Fau, Attorney-General of Algiers, is the President, and two papers are announced for to-day —One by M Robert, on the Humanitarian and Pedagogic Ideas of Jean Comimiac (1572-1670), the other by M Berdellé, on the Employment of Colours as a Means of Retaining in the Mind certain given Numbers

An excellent geological map of Algiers to the scale of 1 in 800,000 has recently been completed, and the formation of it has led to the simultaneous observation of various facts connected with the physical geography of the Central Sahara. A map of the proposed interior sea of the Sahara has also been prepared, and the Trans-Sahara Railway is spoken of as more than a probability But we very much doubt if this can ever be a success If it connected flourishing towns or portions of territory in which great cities are ever likely to be established, as in the case of the new American railways, there would be some hope for it As it is, however over-populated the world may become, there is no likelihood of the formation of settlements in the heart of an unhealthy tropical region G F RODWELL

MR. DARWIN ON VIVISECTION

FROM the *Times* we reproduce the following letter addressed by Mr Darwin to Prof. Holmgren of Upsala, in answer to a request for an expression of his opinion on the question of the right to make experiments on living animals for scientific purposes—a question which is now being much discussed in Sweden —

"Down, Beckenham, April 14, 1881

"Dear Sir,—In answer to your courteous letter of April 7 I have no objection to express my opinion with respect to the right of experimenting on living animals I use this latter expression as more correct and comprehensive than that of vivisection. You are at liberty to make any use of this letter which you may think fit, but if published I should wish the whole to appear I have all my life been a strong advocate for humanity to animals, and have done what I could in my writings to enforce this duty. Several years ago, when the agitation against physiologists commenced in England, it was asserted that inhumanity was here practised and useless suffering caused to animals, and I was led to think that it might be advisable to have an Act of Parliament on the subject I then took an active part in trying to get a Bill passed, such as would have removed all just cause of complaint, and at the same time have left physiologists free to pursue their researches—a Bill very different from the Act which has since been passed. It is right to add that the investigation of the matter by a Royal Commission proved that the accusations made against our English physiologists were false. From all that I have heard however I fear that in some parts of Europe little regard is paid to the sufferings of animals, and if this be the case I should be glad to hear of legislation against inhumanity in any such country On the other hand I know that physiology cannot possibly progress except by means of experiments on living animals, and I feel the deepest conviction that he who retards the progress of physiology commits a crime against mankind. Any one who remembers, as I can, the state of this science half a century ago must admit that it has made immense progress, and it is now progressing at an ever-increasing rate

"What improvements in medical practice may be directly attributed to physiological research is a question which can be properly discussed only by those physiologists and medical practitioners who have studied the history of their subjects; but, as far as I can learn, the benefits are already great. However this may be, no one, unless he is grossly ignorant of what science has done for mankind, can entertain any doubt of the incalculable benefits which will hereafter be derived from physiology, not only by man, but by the lower animals Look, for instance, at Pasteur's results in modifying the germs of the most malignant diseases, from which, as it so happens, animals will in the first place receive more relief than man Let it be remembered how many lives and what a fearful amount of suffering have been saved by the knowledge gained of parasitic worms through the experiments of Virchow and others on living animals In the future every one will be astonished at the ingratitude shown, at least in England, to these benefactors of mankind. As for myself, permit me to assure you that I honour, and shall always honour, every one who advances the noble science of physiology

"Dear sir, yours faithfully,

"CHARLES DARWIN

"To Prof. Holmgren"

THE MAGNETIC SURVEY OF MISSOURI

IN the summer of 1878 the writer began a magnetic survey of the State of Missouri The work of the first summer was confined to the north-east part of the State, and no points of interest were brought out During the summer of 1879 the work was extended over the western half of the State, and it was made apparent that diversity of surface exerted a much more important influence than had been suspected The lines of equal declination were found to bend very sharply upon entering the large valleys, and the needle showed a *tendency* to set at right angles to the valleys This tendency seemed to be greatest when the general direction of the valley made an angle of 45° with the *normal* position of the needle, or roughly, when the valley runs north-east and south-west, or north-west and south-east This tendency seems to be inappreciable when the valleys run north and south, or east and west

In the report of 1878 (*Trans* St. Louis Acad of Sc, vol. iv No 1, p 143) it was suggested that this might result from the bending of the stream-lines of the earth-current sheet, due to the greater conducting power of the moist valleys In order to settle this point, further examination is necessary, and it is proposed to determine the earth-currents at a number of properly selected stations

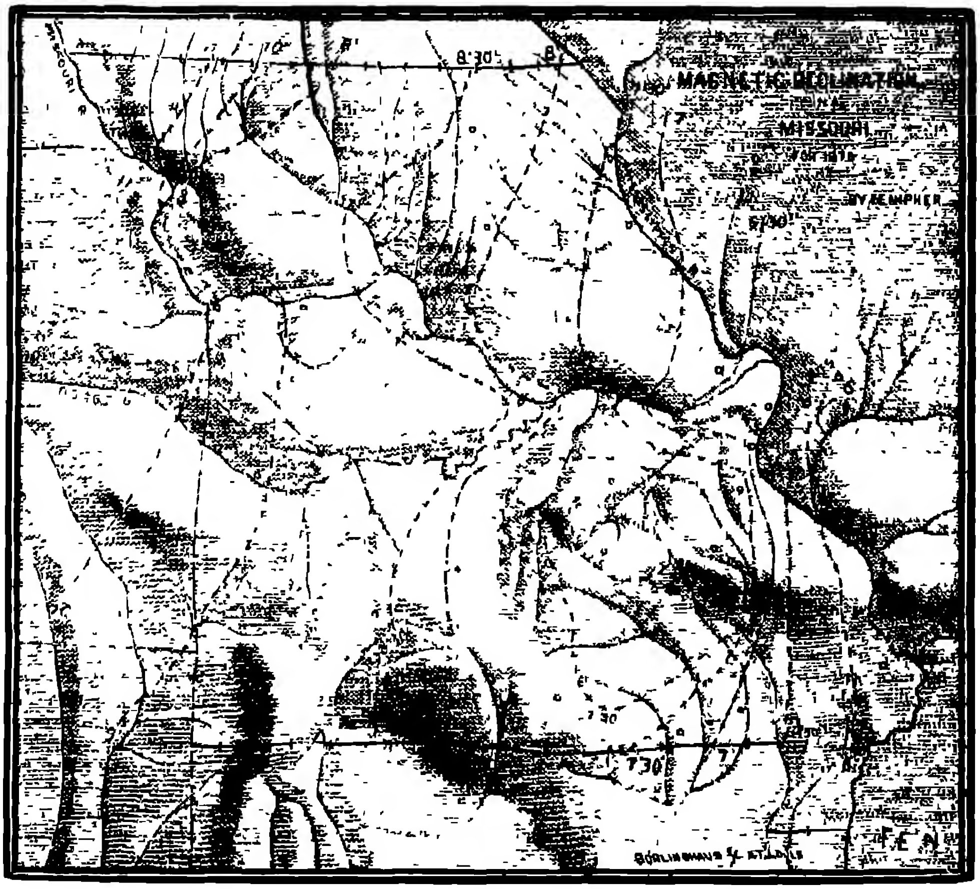
During the summer of 1880 the work extended over the south-eastern part of the State, where still more important flexures of the isogonic lines were discovered Here, however, the position of the needle is probably affected by the iron deposits, and the effect of contour is studied to less advantage At the close of 1880 observations had been made at forty-five stations In order to bring out the effect of contour, a relief map of the State was constructed in wax, and was finally reproduced in plaster. In this work use was made of the profiles of all the railroads in the State, together with a list of over 300 elevations in the State, collected by Gannett. The isogonic lines, which were first drawn upon an ordinary map, in the usual manner, to represent the observations thus far made, were then copied upon the relief map. In doing this it became apparent at once that the forty-five stations were wholly inadequate, and that the isogonic lines thus drawn are probably deserving of about the same weight that a topographical map would deserve if constructed from elevations at these stations

The Chart is made after an artotype, which will accompany the third annual report in No. 2, vol. iv. *Trans* St. Louis Academy of Science In the original map the horizontal scale is twenty miles to the inch, the elevations being exaggerated 200 times This exaggeration was necessary in order to bring out the form in the photograph, since on a relief map, 150 feet square, the

greatest difference in elevation in the State would be represented by a vertical height of one inch The horizontal scale of the cut is sixty-two miles to the inch

The map represents only the grand outlines of surface as obtained from railroad profiles, and barometrical measurements. The dotted lines on the map are lines of equal variation of the magnetic needle thus, on every part of the line marked 8°, the needle points 8° east of north, &c These lines are drawn to represent the observations already made, and show in a general way the variation of the needle in the State. The map also shows that there is a marked relation between the direction of these lines and the contour of the surface. It cannot be said that it shows what this relation is, but it is probably due largely to the deflection of the stream lines of the earth current sheet, caused by unequal conducting power. This explanation necessitates the existence of looped areas in certain regions in the State, the existence of which is already indicated by the determinations The loop in the 7° 30′ line, with its inclosed minimum, is probably complicated with the iron deposits in that region of the State.

Three stations in the Missouri valley have been inadvertently omitted in the cut. One of these (Corrollton) lies on the 8° 30′ line, a few miles north of the river. Another (Glasgow) lies on the river a little south of east from Corrollton. The third (Columbia) lies just east of the 8° line, and about south-east from Corrollton. A fourth station omitted, is nearly due east of the southern terminus of the 8° line, and just outside the 7° 30′ loop. The other stations, represented by the small circles, are shown on the cut, and an inspection of the map will show the weight to be given to different parts of these lines. At stations situated at points of abrupt curvature of the



lines, the observations have been repeated at various localities in the region, until it was clear that no minute local effects existed.

The value in the Iron Mountain region is the mean of many hundreds of determinations made with a solar compass by Pumpelly and Moore in 1872 This region is in the east part of the 7° 30′ loop In the western iron-field, which is nearly coincident with the 7° oval, our observations were repeated at various points (the aim being to *avoid* iron deposits) without finding any local action.

In conducting the survey, a magnetometer belonging to Washington University was used, but the dip circle and declinometer were kindly furnished by Prof. J E Hilgard of the U.S. Coast and Geodetic Survey. Thus far the survey has been conducted wholly on private means, in which we have been aided by the railroad companies, and by citizens of St. Louis. A Bill providing for the completion of the survey is now before the Legislature of the State

FRANCIS E NIPHER

PRIMITIVE MARRIAGE CUSTOMS [1]

THE chief object of Mr Fison's recently published memoir on Kamilaroi marriage, descent, and relationship, is "to trace the formation of the exogamous intermarrying divisions which have been found among so many savage and barbaric tribes of the present day," and to show that what Mr Morgan calls the punaluan family, with the "Turanian" system of kinship, logically results from

[1] "Kamilaroi and Kurnai · Group Marriage, and Relationship, and Marriage by Elopement, also the Kurnai Tribe, their Customs in Peace and War." By Lorimer Fison, M A., and A W Howitt, F G S With an Introduction by Lewis H Morgan, LL D (George Robertson: Melbourne, 1880)

them. His coadjutor, Mr. Howitt, though he has had some interesting information to give about the Kurnai tribes of Gippsland, has had the same chief object; so that the work the two have produced is much more a polemic on behalf of Mr. Morgan than a record of new Australian facts. We must begin, then, by stating what Mr. Morgan's theories are (so far as the work before us is concerned with them), and indicating, and estimating the value of, the evidence on which they rest

Mr. Morgan, having collected a great mass of facts concerning the terms in use between relations and connections throughout the world, and having found that those terms were, broadly speaking, divided into three orders, proceeded to spell out of the two earlier orders (the third consists of the modern terms of consanguinity and affinity) the whole of the early history of marriage and of the family. In what he has called the Malayan system of relationships, parent and child, grand-parent and grandchild, and brother and sister (or rather elder brother, younger brother, elder sister, younger sister, for there are no words for brother and sister) are the only terms in use; and one or other of these terms is used in addressing a person, according as the person addressed is of the speaker's generation or of the generation above, or of that below it They are the terms always used when persons address one another, there being among those who use the system an invincible objection to the mention of their personal names Mr Morgan assumed that those terms were expressive of consanguinity and affinity; and conjectured that when first used they accurately described the relationships at the time existing, "as near as the parentage of children could be known." And it appeared to him that if there were a body of men and a body of women in the same tribe who all regarded each other as brothers and sisters, and all the men married all the women in a group, there would exist a marriage and family system which would explain the Malayan terms- the relationships arising out of which, so far as they were ascertainable, "as near as the parentage of children could be known," those terms would accurately express

Accordingly, he framed the hypothesis that the first stage of marriage was the marriage in a group of men and women of the same blood calling themselves brothers and sisters The family founded upon this kind of marriage he has named the consanguine family, and he regards it as the earliest form of the family. He does not say that such a system of marriage, or such a family system as he has supposed, has been found at any time anywhere, what he says is that this supposition of his explains the origin of the Malayan terms, and that nothing else can explain them. But does it explain them? It is at once obvious that there is one term, and that the most important of all, the use of which Mr. Morgan's hypothesis does not account for Paternity may be doubtful—and if it were thought of at all in a group such as Mr. Morgan has conceived of, any man of the group might have as good a right as any other to be called father of any child born within it. But there can be no doubt about a man's relationship to his mother. In the case of mother and child the parentage is known with certainty, and therefore, on Mr. Morgan's hypothesis, a man should in the Malayan system have had only one mother. Now that system applies the term for mother to many women besides the actual mother—mother's sisters, father's sisters, uncle's wives, and so on, if not indeed to all women of the mother's generation. Here then the hypothesis breaks down; and the point at which we find it breaking down is really the only point at which it can be tested The relationship between mother and child, too, which is confused or ignored in the Malayan system, is the one relationship of which it can be said with confidence that no system really founded on relationship could fail to recognise it. The explanation Mr. Morgan offers is that in the Malayan system the relationship of stepmother "is not discriminated," and there being no name for stepmother, stepmothers had to be called mothers, because "otherwise they would fall without the system" And he has what may be called a subsidiary hypothesis to account for there having been no discrimination between stepmother and mother. It is that the affiliation of children to the groups of men and of women to which they belonged would be so strong "that the distinction between relationships by blood and by affinity would not be recognised in every case." The fact of motherhood would be made little of, that is —there would be no discrimination between stepmother and mother—because the whole group would be, by a child, regarded as its mother But this is equivalent to saying that, from the nature of the case, it was not to be expected that note should be taken of the relationships that could be known, and that is to abandon the hypothesis—as well as to deny us all chance of judging whether it is a good or a bad one. Possibly explanations of the failure of his hypothesis, such as Mr Morgan suggests, might have some weight were he accounting for the Malayan terms as terms of address; but he takes them to denote actual relationships "as near as the parentage of children could be known" And no explanations can get over the fact that the Malayan terms are equally extensive in their application where, in the consanguine family, parentage would be known with certainty, and where it would not be known at all The consanguine family is clearly a bad hypothesis It might be thought it would hardly seem to anybody a plausible one; but Mr. Morgan always speaks of it as if it were among the best vouched of historical facts, and we are bound to say that Mr Howitt believes in it as implicitly as Mr Morgan

To show the hypothesis of the consanguine family to be unstateable is to undermine Mr. Morgan's whole history of marriage and of the family But Mr. Morgan has propounded a hypothesis as to the second form of marriage and the second form of the family, and as it is at this point that Mr Fison (who does not quite believe in the consanguine family) lends him his advocacy, it is indispensable that we should give some account of it. Punaluan marriage, upon which was founded the punaluan family, was introduced by some reformatory movement, according to Mr Morgan, to put a stop to the evils attendant upon brother and sister marriages It existed in two forms In one form of it a group of men, brothers or reputed brothers, had in common their wives who were not their sisters and not the sisters of each other; in the other form, a group of women, sisters or reputed sisters, lived in common with husbands who were not their brothers and not the brothers of each other. Punaluan marriage has not been observed at any time anywhere any more than the consanguine family, but Mr Morgan believes that, in both its forms, it has existed everywhere, and probably during many ages. A correspondent wrote to Mr Morgan stating that in the Sandwich Islands men whose wives were sisters and women whose husbands were brothers called each other punalua, which meant dear friend or intimate companion And possibly drawing his bow at a venture, "the relationship," he said, "is rather amphibious. It arose from the fact that two or more brothers with their wives, or two or more sisters with their husbands, were inclined to possess each other in common" Whether conjecture or fact, this amounts to very little, but it was this which gave Mr. Morgan the suggestion of punaluan marriage For proof of his hypothesis he again relied upon the terms he had collected—and at first upon its fitness to explain those same Malayan terms which, as we have seen, have more than enough to do to bear the weight of the consanguine family. In his latest work ("Ancient Society") he holds it to be proved by a nomenclature considerably

different from the Malayan—his second order of terms which he has named the Turanian system of relationships. He regards the terms in this system also as accurately describing, "as near as the parentage of children could be known," the relationships existing at the time when they came into use. It differs from the Malayan in including words for cousin, uncle and aunt, and nephew and niece—or words which Mr Morgan has so translated. It will be found, however, that Mr Morgan does not use the punaluan family in accounting for any one of the Turanian terms. Those of them which coincide, or partly coincide, with the Malayan terms he had already accounted for by the hypothesis of the consanguine family, and he does this over again, the others he accounts for, or tries to account for ("Ancient Society," pp. 442-445), by means of exogamy alone. His reasoning is exactly what it would have been had the punaluan family never occurred to him. Indeed it has been an embarrassment to him, he has had to keep it out of his reasonings. For the punaluan family is, *ex hypothesi*, in two forms, and neither form could, "as near as the parentage of children could be known," yield both the Turanian sense of father and the Turanian sense of mother. Where the husbands were punalua, Mr Morgan's reasoning would make them all, though not brothers, fathers of children born within the group, and it would exclude their brothers from being considered fathers. But, in the Turanian system, a father's brothers are called fathers Similarly where the wives were punalua, Mr Morgan's reasoning would make them, though not sisters, all mothers of the children of each of them, and would exclude their sisters from being considered as mothers But, in the Turanian system, a mother's sisters are called mothers. Mr. Morgan has not failed to see this, and he has actually again framed a subsidiary hypothesis to give his hypothesis of the punaluan family a chance of living This is (see "Ancient Society," p. 445) that where a group of sisters married men who were not brothers, they also became the wives of all the brothers "own and collateral"—that is, all the brothers and one-half of the cousins, however far removed—of each of their husbands, and, similarly, that when a group of brothers married women who were not their sisters, they also became the husbands of all the sisters and one-half of the cousins of each of their wives All that need be said of this subsidiary hypothesis is that it gives quite a new look to the punaluan family—and that the effect of it, like that of the secondary hypothesis formerly noticed, is to deny us all chance of judging whether the principal hypothesis is a good or a bad one The justification offered for it is that "the system (the Turanian) treats all brothers as the husbands of each other's wives, and all sisters as the wives of each other's husbands, and as intermarried in a group"—but that is equivalent to saying that the system has taken no impression of the punaluan family, and gives no countenance to Mr Morgan's hypothesis. As, apart from "the system," he finds nothing to say for it, it is difficult to see how any one can resist the conclusion that that hypothesis must be dismissed, and that it must be ranked among the wildest chimeras that have ever possessed the brain of a man of science.

Now, do Mr. Fison and Mr. Howitt give in any degree to Mr. Morgan's hypotheses the support of which they are in need? The answer must be no—and must be no even if we receive as facts the assumptions as to fact from which they set out. Mr. Howitt accepts both the consanguine family and the punaluan family, while Mr. Fison offers himself as the advocate of the latter only. But Mr. Howitt has nothing new to say for the consanguine family, he believes in it, and argues from it as if it were known historical fact—that is all; and so of it no more need be said. What then do his colleague and he find to say for the punaluan family? Literally, not a word Mr Howitt simply takes it for granted as he does the consanguine family. Mr. Fison, in beginning, undertakes to show that it results logically from his hypothesis —for it is no more than that—of "exogamous intermarrying divisions." but he does not attempt to do so. And, in fact, his "intermarrying divisions" are quite different from the punaluan family, and leave no need for it, and no room for it, that is, his hypothesis is different from and exclusive of Mr. Morgan's In Mr Fison's hypothesis, a group of men who are considered brothers and a group of women who are considered sisters—being the men and women of the same generation in two divisions which intermarry with each other, and only with each other—are by birth husbands and wives to each other; whereas, in the punaluan family, when the husbands are brothers the wives are not sisters—they are punalua; and when the wives are sisters the husbands are not brothers—they are punalua Men who are brothers are restricted to women who are each other's sisters, on Mr Fison's hypothesis, but, on Mr Morgan's, men who are brothers marry women who, as a rule, are not each other's sisters The marriage law shown in Mr Fison's hypothesis would have to be given up before the punaluan family could have a chance of issuing out of the intermarrying divisions Then, as Mr. Fison justly observes, his intermarrying divisions "would have precisely the reformatory effect" which Mr Morgan attributes to the punaluan family—so that, given the divisions, the punaluan family would not be needed for reformatory purposes, and as Mr. Fison's view is that the totem clan grew up within his divisions, while their marriage law still subsisted, the punaluan family would not be needed to give birth to the clan (which Mr Morgan says it has done). And, clearly, there would be no more room than need for it. It thus appears that, instead of supporting the hypothesis of the punaluan family, Mr. Fison has put it aside, and offers an improved hypothesis (suggested, no doubt, by Mr. Morgan's) in place of it We have seen that he does not accept the consanguine family either. He does not, indeed, repudiate it. But to connect it with his intermarrying divisions seems to him so difficult that he thinks the one could have been changed into the other only through the intervention of "a higher power." He is not afraid of the ridicule to which he might be exposed were he to account for the first formation of the divisions by such a hypothesis, but he thinks it unnecessary to go behind them We have now shown in what manner Mr. Fison supports Mr. Morgan—and we have shown that Mr Morgan is in no position to give any support or countenance to him.

To show that the Turanian terms would result logically from his own hypothesis is what Mr Fison has attempted. There are in a tribe two divisions which do not permit marriage within the division, and are restricted to intermarrying with one another. All the men in one division are the husbands of all the women of the same generation in the other, the wife does not come into the husband's division; and descent is reckoned through the mother. The group of men marries the group of women, and it is the group that is husband, the group that is wife, the group that is father, mother, son, or nephew, every person in it taking, however, all the relationships that arise to it Such is the hypothesis. Seeing that the relationships are called group relationships, it might be thought that Mr Fison considered the Turanian terms to have been, in the first instance, something other than terms of blood-relationship, say terms of address; but he denies that they are terms of address, and regards them as having been real relationships from the first. In what natural sense of relationship, however, a group—or the women in it other than the actual mother—can be mother of a child he does not tell us; and till he can make this plain, his theory must be held to be as untenable as the hypothesis of the consanguine family. As for his demonstrations (Q E.D at the end of each) of the Turanian

terms, we can scarcely pretend to follow them The terms which are specially Turanian are laid down by him in definitions, and these definitions are used in the demonstrations—so that, so far as these terms are concerned, he seems to assume what he is going to prove On p. 87 (Prop 12) he proves that certain groups are cousins by the mere statement of three definitions. What is also odd is that, immediately after, he proves, by a process of reasoning, that the same groups are not cousins, but brothers and sisters-in-law. Similarly, he proves first that a group is another group's nephew, and then that it is its son-in-law. This brings us to say that the terms which Mr Morgan has translated uncle, aunt, nephew, niece, and cousin, and which he regards as denoting relationships, according to Mr Fison really mean father and mother-in-law, and brother and sister-in-law only, and express nothing except that a person is called father or mother, brother or sister, as the case may be, by a man or woman whom one is free to marry How these could, with group marriage, be more than terms of address it puzzles us to see What it is necessary to notice in these demonstrations, however—and nothing else is really necessary—is that while by hypothesis descent is reckoned through the mother—which must show that relationship had to some extent been the subject of thought—and "so far as descent is concerned, the father is a mere nonentity," they all proceed on the view that the father, who on the hypothesis would be in each particular case unknown, is as much a relative as the mother Having said this, no more need be said of Mr Fison's demonstrations. It should be added, however, that the terms in use among relatives in Australia are, so far as Mr Fison can learn, in the main Malayan—and he has no theory to account for the Malayan terms. He knows nothing at all of the terms in use among the Kamilaroi He has himself found the native terms "exasperatingly puzzling." Several terms may be used by the same people for one relationship, and, as he says, matters other than relationship appear to be taken into account. The ceremony of initiation, for example, affects the words by which a man will designate another, though, as Mr. Fison says, it "does not touch their relationship"

As to the hypothesis itself, an essential part of it (and indeed of Mr. Morgan's hypotheses too) is that, as regards the intercourse of the sexes, there should have been no mixing of generations—that only men and women of the same generation should have been husbands and wives. A generation, apart from particular families, can be defined only loosely, but for Mr. Fison's purposes it should be definable with some precision At any rate, his theory requires that the elderly men should have been kept separate from the young women, and the young men from the old women But what an assumption this is—especially to make primarily of Australian natives, of whom nothing is better known than that the elderly men monopolise the women, and especially the young ones, and that a young man (though much license is allowed) hardly ever gets a wife, unless it be an old one, except by running away with her. This assumption, experience being dead against it, is of itself enough to put out of the field the hypothesis of which it forms a part. The idea of intermarrying divisions with groups of husbands all brothers, and groups of wives all sisters, no doubt sprang out of the hypotheses of Mr Morgan, but apart from Mr Morgan, it has a history which must be told Briefly, it was suggested by a traveller's mistake.

In 1853 the Rev. William Ridley, a Presbyterian clergyman of Sydney, published a statement as to the marriage rules of the Kamilaroi, which statement is now known, on Mr Ridley's own authority, to have been essentially erroneous. Mr Fison still treats it as entirely true, and treats all later and more correct information as if it gave facts of a later order. Mr. Ridley said that the Kamilaroi were divided into four castes of men and four of women, and that (with one exception) the men of a caste could marry only women of one other caste. Murri, feminine mata, kubbi, feminine kubbitha; kumbo, feminine butha, and ipai, feminine ipata, were the castes; and he said that a murri could marry a butha and no other woman, and that his children were not murri and butha, but ipai and ipata, and that, similarly, a kubbi could marry only an ipata, his children being kumbo and butha; and a kumbo only a mata, his children being kubbi and kubbitha; while an ipai, besides being free to marry any kubbitha, could marry any ipata not of his own family—his children, when he married a kubbitha, being murri and mata, and when he married an ipata, kumbo and butha. Mr Ridley repeated this statement without change in 1855, and he told it in 1871 to Mr. Fison with this amount of change, that instead of castes he now spoke of classes (in unhappy imitation of Mr Morgan), and of four classes, with men and women in each, instead of four classes of men and four of women, and that he described the marriage of ipai with ipata (that is with a woman of his own class) as an infringement of rule—changes that may fairly be ascribed to the initiative of Mr Fison. Mr Fison, putting aside the marriage of ipai with a woman of his own class as an irregularity, and idealising Mr. Ridley's statement, at once formed the hypothesis that all the men of one class originally were by birth the husbands of all the women of the same generation in the class with which they might intermarry. This, although he knew from Mr. Ridley that polygamy was largely practised among the Kamilaroi Much licence was allowed; and the only word for spouse signified a person whom one is free to marry, and these two facts seemed to him to override Kamilaroi practice, and to prove that marriage had been communal, to begin In the same year (1871), however, Mr Ridley was again among the Kamilaroi, and sent to Mr Fison a statement which should have shaken his faith in his hypothesis—both because of the new matter it contained, and because there were in it what he himself perceived to be errors of observation Mr Ridley has published several statements since, all containing obvious errors of observation or slips of memory, and it is impossible to receive even his latest statement as final. But observe what his latest statement is, and compare it with Mr. Fison's hypothesis. It is that the Kamilaroi are divided into totem clans (iguanas, paddy-melons, opossums, emus, blacksnakes, bandicoots); that every native has three names—a personal name (carefully concealed), a "class" name, and a totem name, that children take both the class name and the totem name through the mother; that the men and women of every class are free to marry one another, provided they are not of the same totem—and that, besides, murri may marry any butha, kubbi any ipata, kumbo any mata, and ipai any kubbitha If his statements can be trusted, murri and butha, kubbi and ipata, kumbo and mata, and ipai and kubbitha, who are free to marry one another, are never of the same totem—so that all the marriages which certainly are permitted are marriages between persons of different totems Mr. Ridley still leaves each class restricted from intermarrying with two others. So much of his original statement he has not yet found to be wrong. But the class name does not prevent marriage within the class. The notion that the Kamilaroi were in intermarrying or husband and wife "castes" was certainly erroneous Is it likely then that the class-name is any bar to marriage outside the class? Is it not far more likely that there is still something for Mr. Ridley or some other inquirer to find out, and that, in the main, identity of totem is the only bar to marriage? We say in the main, because it is very likely that there are also regulations to prevent marriage between persons near in blood who are of different totems. Mr. Lance, who is a great authority with Mr. Fison, and who was Mr. Ridley's first informant, had got into his

head that the Kamilaroi were divided by their names into castes with the marriage law which Mr Ridley first described, and, meeting with an ipai whose wife was an ipata, he regarded him as a daring transgressor of the customary rule. The man told him that he and his wife were free to marry because they were not of the same mudji (totem); and, thereupon, Mr. Lance (who evidently had never before heard of totems) told Mr. Ridley that the ipai were privileged above their neighbours in being free to marry women of their own class who were not of the same family with them, and Mr. Ridley told the world that they were the aristocratic caste among the Kamilaroi (He has since stated that the murri are the aristocratic class.) This is the sort of observation we are questioning Had Mr. Lance seen in operation a rule intended to prevent, say a man from marrying his own daughter, he might easily have magnified it into a rule prohibiting two whole "castes" from marrying. And in all probability it was something like this he did. It is the ludicrously wrong impression he had before he met the ipai aforesaid that Mr Fison has taken for the basis of his hypothesis—but from even that to the hypothesis is a tremendous jump And, after all, even if we overlook the inadmissible assumption which forms an essential part of the hypothesis, it appears not to be good for anything

What have been called caste or class names appear, so far as the evidence goes at present, to be names merely, and to have no effect on the right of intermarriage. The system of naming is certainly very peculiar The names alternate in successive generations That is not in itself peculiar, but the same name is taken by all the sons, the same name by all the daughters Thus ipata's children are the sons all kumbo, and the daughters all butha, and, again, butha's children are ipai and ipata It is a pretty widely spread system. Mr Howitt says that, as far as he knows, it prevails among all Australian tribes, but this is going a vast deal too far; and is calculated to undermine faith in Mr Howitt's judgment, for it plainly does not prevail among the Kurnai whom he himself has described His report shows nothing like castes or classes among them, the men, he says, are all called yeerung (emu-wren) by the women, and the women all djeetgun (superb-warbler) by the men, but this (whatever it may mean, and it may mean very little) does not divide the Kurnai into anything other than men and women Mr. Fison has had from a number of correspondents statements which he takes to mean that among tribes other than the Kamilaroi which have this system of naming, there is no marriage between persons of the same name; but his correspondents are neither, as regards opportunity or observing power, above Mr. Lance; and Mr Ridley's study of the Kamilaroi, imperfect as it has been, gives the only evidence that can be regarded as trustworthy. Mr Fison has amended the list of marriages allowed among the Kamilaroi, given by Mr Ridley, as he says, on later information, but anonymous information cannot be thought of much value on this matter as against the authority of Mr Ridley. Mr Fison is too easily satisfied with anything that seems to make for his view to be kindly trusted in such a matter We find him inferring from there being no marriage between blood-relations—which may mean totem clans—among people who have the class names that there is no marriage within the class. We find totem clans, too, reported to him as classes and ranked by him as classes; and "divisions," which probably mean totem clans, are also ranked by him as classes. On the other hand he candidly gives at least one case in which the class-names are said not to restrict marriage. He gives at the very beginning of his book a native legend of brothers and sisters having married at the first—a legend which both Mr Morgan and he make much of We are surprised, however, at his missing the true point of it. What it exhibits is not a movement to "intermarrying divisions" or classes, but to the establishment of totem clans. *These* are all the natives seem to have thought in need of explanation.

We should have been glad to notice Mr. Howitt's account of the Kurnai at some length, but we must be brief. The Kurnai have kinship through males and exogamy—that is, prohibition of marriage within the kindred; and as was to be expected in such a case, the kindreds form local tribes. He does not expressly tell us whether or not these clans or local tribes are distinguished by totems (which shows that he meant to be careful, and that his information was very far from being complete), but incidentally he lets out that they are. When a Kurnai young woman meets a young fellow who, being a stranger, looks as if he might make a husband for her, Do you eat kangaroo, opossum, blacksnake? is her first question after saluting him Presumably the animal she names is her own totem If the stranger may eat it he can marry her As for his discovery of marriage by elopement, we have no doubt that it is (as a missionary friend of his, Mr. Bulmer, hinted to him it must be) a mere product of misconception Young men among the Kurnai, he says, could get wives only by eloping with them on the proposal of the women This may be, an Australian young man could scarcely ever get a wife except by running away with her But how did the elderly men get their wives? He appears never to have asked that. But he is aware that there was a system of exchanges The Kurnai are polygamous, and no doubt among them, as among other Australians, the elderly men had, by means of exchanges, nearly all the young women for wives Mr Howitt writes so candidly, and his account of the Kurnai is in many respects so interesting, that we should gladly have brought ourselves to think better of this discovery of his But after reading Mr Fison's most amazing account of the origin of marriage by elopement, we find ourselves shut up to holding that it is simply a big blunder Nothing else could have elicited so preposterous an explanation But such words as preposterous fall harshly on the ear, and we would part from our authors without unkindness Their exertions to advance a growing science are truly commendable. If the result has been rather to mystify than to elucidate, there is but one more illustration of the way in which good intentions, industry, and ingenuity are wasted when men have started in the wrong track.

D MACLENNAN

NOTES

THE evening discourses at the meeting of the British Association at York will be delivered by Prof. Huxley and Mr Spottiswoode. Mr Huxley will speak of the "Rise and Progress of Palæontology" on Friday, September 2, and Mr Spottiswoode "On the Electric Discharge, its Forms and its Functions," on Monday, September 5.

THE Honorary Fellowship of the Royal College of Surgeons in Ireland was on Wednesday last week conferred on Prof Helmholtz, and the Honorary Degree of LL.D. by the University of Dublin. On Monday night, at an ordinary meeting of the Royal Society of Edinburgh, Sir William Thomson in the chair, Prof. Helmholtz read a paper on "Electrolytic Conduction." There was a crowded attendance, and Prof. Helmholtz was warmly received.

ON Monday the National Fisheries Exhibition, which has been organised at Norwich under the care of numerous public bodies, from the Board of Trade downwards, was opened by the Prince and Princess of Wales. The exhibition is divided into six classes, as follows:—1. Pisciculture and shell-fish culture; 2. Models, trawling gear, drifting gear, canvas and ropes, and inland fishing tackle, 3. Life-saving apparatus, lamps, fog-horns, signalling, &c., architectural plans for fish markets, fish-curing

establishments, fish vans, and fishermen's clothing, 4. Pictures, utilisation of condemned fish and fish refuse as a manure, and the cleansing of sewage-polluted streams; 5. Dried, salted, smoked, and tinned fish, shell fish, fish oils, manure, and disinfectants, aquatic flora and fauna, and birds which prey upon fish, 6. Loans There is in the last class a fine collection of casts made by the late Frank Buckland, which has been lent by the authorities of South Kensington Museum The exhibits of preserved specimens of aquatic, or rather fish eating, birds is also highly interesting and instructive. In the class devoted to the culture of fish there are a large number of tanks, troughs, and the various appliances for hatching the ova of fish, for rearing the young fry, &c There are also shown live fish in a series of aquaria, amongst which are specimens of nearly every variety of fresh-water fish indigenous to this country, the local fauna being especially complete Next week we hope to give the address which Prof Huxley, who is now one of the Inspectors of Fisheries, delivered in connection with the Exhibition

From the *Sydney Morning Herald* we are glad to learn that a zoological station is at last to be established at Watson's Bay, under the direction of Baron N. de Miklouho Maclay, on a small grant of land obtained from the Government After a lengthy absence at the Melanesian Islands and in Queensland he has returned with the intention of remaining in Sydney until he can complete what he began in 1878, and see the zoological station firmly established. The land granted by the Government at Watson's Bay is situated near Camp Cove, and is about half an acre in extent Upon this a cottage of five work-rooms will be erected, and this building will be for the use of naturalists who visit New South Wales for the purpose of studying the zoology and botany of Australia The Government, understanding its scientific value, have given what assistance they can, and have promised that if 300*l.* be collected by private subscription a similar sum will be contributed towards the expense of erecting the building from the public revenue The subscriptions up to the present amount to about 200*l*, and it is hoped there will be no difficulty in obtaining the balance which will be necessary for forming the zoological station on the small scale contemplated for a beginning This station will be the first of the kind in the southern hemisphere, and will supply a serious want.

The death is announced, at the end of February last, of Mr Gerard Krefft, the Australian naturalist Mr. Krefft was born in Brunswick, Germany, in 1830, and early conceived a taste for natural history. After spending some time in the United States he went to Melbourne in November, 1852. Mr Krefft was selected to accompany the collecting expedition fitted out by the Victorian Government, 1858 Having succeeded the leader in command of the party he returned to Melbourne with a large collection of specimens and a well-filled portfolio, and was engaged by Prof. M'Coy as assistant in the Museum He gave a report in full about the animals obtained and an account of the manners and habits of the aboriginals, illustrated by numerous sketches He then resigned his position and returned to Germany In 1859 he again left home for foreign lands, having obtained from the Hamburg firm, Messrs. Godeffroy and Son, a free passage for a trip round the world, and after a two months' sojourn in South Africa he took up his quarters in Sydney, being appointed secretary to the Australian Museum and assistant to the late Dr Pittard, its curator. On the death of that gentleman Mr. Krefft succeeded to the vacant curatorship in 1861. During the latter years of his appointment he had a series of disagreements with the trustees of the Museum, which resulted in his leaving that institution, September, 1874 Mr. Krefft was probably the first man who thoroughly studied the reptiles of Australia Mr. Krefft was a F.L S., C.M.Z.S, and Member of various other learned societies.

Among Mr Murray's forthcoming works are the following:—"The Formation of Vegetable Mould through the Action of Worms, with Observations on their Habits," by Charles Darwin, F R S.; "The Life and Letters of the late Sir Charles Lyell, Bart," edited by his sister-in-law, Mrs. Lyell, "The Land of the Midnight Sun," being a narrative of summer and winter journeys through Sweden, Norway, Lapland, and Northern Finland, by Paul B du Chaillu, of gorilla fame; also a second and revised edition of Mr. W. H White's "Manual of Naval Architecture."

At the meeting of the Sanitary Institute of Great Britain on April 13, Dr. Richardson read a paper of suggestions for the management of cases of small-pox and of other infectious diseases in the metropolis and large towns. Dr Richardson maintains the thesis that there should be no aggregation of infectious cases in large central institutions, and describes the objections to such aggregation. He suggests further that the sanitary committee or authority in every parish should have al the special centres of infection in each of its districts thoroughly mapped out, and that it should know, on a calculation of cases occurring in quinquennial periods, what is the permanent accommodation required for its infectious sick He urges that the required accommodation being known, the local authorities should keep ready at all times within the parish such necessary accommodation in small hospitals situated in different parts of the parish or locality Dr. Richardson described what he thought should be the size, mode of construction, and position of such hospitals —(*a*) That each hospital should not be larger than is sufficient to receive twenty-four persons at one time (*b*) That each should be constructed on the separate system for the patients (*c*) That each should be constructed of iron, so that it may at any time be absolutely purified by fire throughout all its structure. (*d*) That each should be placed on the upper storey of a building, forming in fact the top storey of one or more houses, so that it may be lighted and ventilated directly from its roof. (*e*) That all the air that passes out of the hospital when it is occupied by infectious persons should pass through fire (*f*) That each patient should be carried into the hospital by a valved lift, which lift should pass through a shaft, so as to draw up air during its ascent, and which should, when required, be effective for flushing the hospital with air. Dr. Richardson entered into the subject of the organisation of these hospitals in respect to general supervision and nursing. Under this head he recommends—(*a*) That the general supervision should be in the hands of the Medical Officer of Health. (*b*) That the nursing, also under the supervision of the Medical Officer of Health, should be carried out by trained nurses, who might be educated to their work in the Union infirmaries Lastly he suggested that the medical attendance should be conducted by a special staff of duly qualified medical men acting under the Medical Officer of Health and responsible to the local authority, by whom they should be approved and remunerated. An interesting discussion followed, which was adjourned to the 27th inst

Under the auspices of the National Health Society the following Drawing-Room Lectures will be delivered at 23, Hertford Street, Mayfair (by kind permission of Mr. Charles Matthews), to commence at 4 o'clock p.m.—Friday, April 22 Prof. Fleeming Jenkin, F.R S., "Sanitary House Inspection", Friday, April 29 · Dr. Robert Farquharson, M.P (formerly Medical Officer of Rugby School), "Health in Public Schools"; Friday, May 6 · Mr. C. N Cresswell, "Sanitary Relations of Local Self-Government", Friday, May 13: Mr. Henry Power, M B, F.R C.S., "Care and Education of the Eye", Friday, May 20: Dr. Siemens, F.R S, LL D., "Stoves and Grates"; Friday, May 27: Mr. Ernest Hart, M.R.C.S., "Recent Progress in Health Knowledge" Tickets may be obtained from the

secretary at the offices of the Society, 44, Berners Street, on Mondays and Fridays from 2 to 5, or will be forwarded by post on application. Patronesses: H.R.H. Princess Christian; H.R.H. Princess Louise, Marchioness of Lorne; H.R.H. Princess Mary Adelaide, Duchess of Teck. The president of the Society is His Grace the Duke of Westminster, and the Chairman of Council, Mr. Ernest Hart, M.R.C.S. The objects of the Society are to diffuse sanitary knowledge in every possible way, by the delivery of simple practical lectures on air, ventilation, food, and cookery, the prevention of the spread of infectious disease, and kindred subjects, at working men's clubs, mothers' meetings, and elsewhere, in all parts of London and the suburbs, by the circulation of sanitary tracts and papers; by encouraging the teaching of the laws of health in high schools and Board schools, by offering prizes, &c., to both teachers and pupils; and to secure open spaces for the healthy recreation of the people Membership is constituted by the payment of 1*l*. 1*s*. annually; life membership by the single payment of 10*l* 10*s* Communications to be addressed to Miss Lankester, the Secretary, at the offices of the Society, 44, Berners Street, Oxford Street. It is evident that this Society has adopted effectual means to do a good and highly necessary work; it deserves the heartiest support from all who can in any way lend a helping hand.

TWO Art Exhibitions were opened under the auspices of the Sunday Society on Easter Sunday, one at Whitechapel, the other in New Bond Street. That at the East-end consisted of a Loan Collection of Paintings, &c, organised by the Rev. S. A. Barnett, to which the Council on Education contributed largely from the National Collection at South Kensington More than 2500 persons visited the Exhibition during the day, it being open from 2 till 9 p m. The West-end Exhibition was the first Exhibition of the new Society of Painter-Etchers at the Hanover Gallery, and this was visited by about 578 members of the Sunday Society between the hours of 4 and 6 30 p m. On Sunday, April 24, this Exhibition will be open to ticket-holders. Free tickets may be had by all who make a written application, inclosing a stamped and *addressed* envelope to Mr. Mark H Judge, Hon. Sec of the Sunday Society, 8, Park Place Villas, W.

THE second series of meetings organised by the Sunday Evening Association at the Neumeyer Hall was brought to a successful close on Easter Sunday by a lecture on "Lessing," by Mr. Moncure D. Conway. The hall was crowded, and at the close it was announced that the first annual meeting of the Association would be held in May, and that in the autumn the Committee intended to organise a series of meetings in the different Metropolitan suburbs, in order if possible to start local branches. The object of the Sunday Evening Association is to bring together all persons who, estimating highly the elevating influence of music and the sister arts, literature and science, desire by means of meetings on Sunday evenings to see them more fully identified with the religious life of the people. The subscription is 2*s* 6*d*. per annum, which may be paid to the treasurer, Mr. Godfrey Shaen, 15, Upper Phillimore Gardens, W

WE take the following from the *Electrician* —The following correspondence over the telephone wires yesterday, says the Kansas City *Times*, is a further proof of the fact that no one but a bald-headed man could do without one:—"Hello, central!" "Hello!" "Connect me with the signal bureau." "All right—go ahead." "Hello, signal!" "Hello!" "Is it going to thaw to-day?" "Yes, there are indications." "How's the wind?" "Getting round to the south." "Do you think I can safely have my hair cut?" "Wait a minute until I consult the barometer, thermometer, and wind gauge." (Silence for half a minute.) "Hello!" "Hello!" "Yes, you can go ahead. There won't be any change to speak of for the next twelve hours. There is a cold wave moving up the Ohio River, and a snow-storm is reported at Cheyenne, but if I were you I'd take my chances on the hair-cutting." "All right —much obliged" "Good bye"

MR. PFOUNDES has reprinted, in a separate form, his short but interesting paper at the Anthropological Institute, on the "Japanese People: their Origin and the Race as it now exists."

THE usual meeting of delegates of the Sociétés Savantes takes place this week at the Sorbonne on a somewhat enlarged scale It is the first time that members of Parisian societies will meet in combination with their provincial brethren

A NEW fortnightly journal, *L'Electricien*, has appeared in Paris.

THE *Times*' Swiss correspondent states that the acclimatisation of the ibex in Switzerland would appear to be so far a success. The herd which was turned out some time ago in the Grisons is reported to have got through the winter without damage and as being at present in an excellent state of health.

A CORRESPONDENT of the *Daily News* points out that the exact time of the great Chios earthquake on the 3rd inst. was 1 50 p m.

No 2 of vol III. of the *American Antiquarian and Oriental Journal* (Chicago, Jameson and Morse) contains several contributions relating to American archæology, especially on the mound-builders The editor, the Rev S D. Peet, has an article on the military architecture of the emblematic mound-builders, and there are various other contributions from various parts of the States bearing on the life and works of the prehistoric peoples of America In the Oriental department various interesting points connected with Eastern antiquities are discussed.

PROF CORNELIUS DOELTER of Gratz has safely returned from his journey to West Africa. He has brought home mineralogical and ethnographical collections.

THE Report of the West Kent Natural History Society speaks of its continued prosperity. It contains an interesting address by the President, in which he points out certain important bearings of recent researches on light. Speaking of the Blackheath holes, the President is inclined to think they are over the sites of pockets or pipes in the chalk, and that the cause of the subsidence is the drawing away of the subsoil by the action of water, the subterranean drainage produced by the pumping up of the water by the Kent Water Works at Deptford, drawing away sand and chalk in mechanical suspension.

THE following are among the papers in the *Transactions* of the Cumberland Association, part v.:—"Distribution of Boulders in West Cumberland," by J. D. Kendall, F.G.S.; "Soul-Cells and Cell-Souls," from the German of Haeckel, by the Rev. C. H Parez, "The Influence of Geological Structure on Scenery," by Mr. Kendall; "The Local Museum and its Relation to the Natural History of the District," by Mr. James Arlosh, "The Moths of the District," by Mr. George Dawson; "The Character and Distribution of the Diatomaceæ," by Mr. B. Taylor; "Notes on Inglewood Forest," by Mr. John Jackson.

AN Electric Railway is being laid down in the grounds of the Crystal Palace.

THE Academy of Natural Sciences of Philadelphia are giving Spring courses of instruction in Invertebrate Palæontology and Mineralogy.

THE additions to the Zoological Society's Gardens during the past week include a Common Rhea (*Rhea americana*) from South America, presented by Mr. A. D. M. Stewart; a Mountain Ka Ka (*Nestor notabilis*) from New Zealand, presented by Dr. A. de Lantour, M.R.C.S.; an Undulated Grass Parrakeet (*Melopsittacus undulatus*) from Australia, two Californian Quails (*Callipepla californica*) from California, two Common Quails (*Coturnix communis*), a Greenfinch (*Ligurinus chloris*), a Goldfinch (*Carduelis elegans*), two Chaffinches (*Fringilla coelebs*), two Common Crossbills (*Loxia curvirostra*), a Common Lapwing (*Vanellus cristatus*), British, a Barred Dove (*Geopelia striata*), a Nutmeg Bird (*Munia undulata*) from India, two Rufous necked Weaver Birds (*Hyphantornis textor*) from West Africa, two Mecca Pigeons (*Columba oenas*, var.), from Tunis, presented by Mr. H. H. Johnston; a Green Turtle (*Chelone viridis*) from West Indies, presented by Mr. J. C. Robinson, R.M.S. *Dunrobin Castle*; a Common Viper (*Viper berus*), two Common Snakes (*Tropidonotus natrix*), British, presented by Mr. J. Poyer Poyer; a Red-faced Saki (*Brachyurus rubicundus*), a Horrid Rattlesnake (*Crotalus horridus*) from South America, a Brown Bear (*Ursus arctos*) from Spain, a Great Kangaroo (*Macropus giganteus*), two Ursine Dasyures (*Dasyurus ursinus*), three Vulpine Phalangers (*Phalangista vulpina*) from Australia, deposited; a Beisa Antelope (*Oryx beisa*), a Banded Ichneumon (*Herpestes fasciatus*), a Squirrel-like Phalanger (*Phalangista sciureus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

THE SOLAR PARALLAX.—M. Puiseux, in a communication to the Academy of Sciences of Paris, discusses the numerous micrometrical measures made during the last transit of Venus by MM. Mouchez and Turquet at St. Paul's, and MM. Fleuriais and Bellanger at Pekin. If these observations had possessed a high degree of precision he considers that they would have furnished a very exact value of the solar parallax, but unfortunately, so far at least as regards the measures at St. Paul's Island, the conditions were extremely unfavourable; indeed in a note which follows M. Puiseux's communication Admiral Mouchez remarks that the equatorials provided for that station had no special appliances for this class of observation, and worse still, "les observations ont été faites exactement au moment du passage du centre d'un violent cyclone, pendant la courte éclaircie qui accompagne la plus grande dépression barométrique." The instruments in fact were more particularly adapted to proposed observations of contacts, and were very weakly mounted; oscillations were occasioned by the violent wind, so that the practised observers had no confidence in their results. Notwithstanding these circumstances M. Puiseux has discussed the measures, and from the combination which he regards as the most favourable, where 81 observations that appear affected with considerable errors are rejected, leaving 312 measures for calculation, he deduces for the value of solar parallax 9"·05; the mean value of the corresponding residuals is 0"·78, and the extreme residuals −1"·98 and +2"·15. Considering that under such disadvantageous conditions the observations accord passably, M. Puiseux thinks there are reasonable grounds to expect that with firmly-mounted instruments micrometrical measures may be obtained at the approaching transit in 1882, which will furnish a pretty exact value of the sun's parallax.

THE DOUBLE-STAR HERSCHEL 3945.—The double-star to which Mr. Birmingham drew attention in NATURE last week on the score of contrasted colours of the components and variability of the principal star has a longer history than is noted in his letter. It is found as a single star of sixth magnitude in Bode's Catalogue, from his own observation, and is Canis Majoris 164. Lalande observed both components on March 2, 1798, magnitude 5 and 7. On January 23, 1835, Sir John Herschel, observing at the Cape, calls them 7 and 8, "large star orange: small, pale blue"; and on January 31, 1837, he estimated the magnitudes the same: "large star, very high yellow; small, contrasted blue"; these observations occur in Sweeps 532 and 768. Amongst his micrometrical measures we find for the epoch 1837·153 magnitudes 6½ and 7, and for 1837·301 magnitudes 6½ and 8, with the note "Orange and green, fine contrast of colours." Next we have three meridian observations of the principal star by Argelander in vol. vi. of the "Bonn Observations," on January 26 and March 13 and 14, 1854, magnitudes noted, 5·5, 4·5, and 5·0, and one observation of the companion on March 23 in the preceding year, when it was estimated 7·5. In Heis and Argelander the naked-eye estimate is 5 m. The components are separately noted in Gould's *Uranometria Argentina* A 5¼ red, B 7. The star does not occur in D'Agelet, Taylor, or in Argelander's Southern Zones. The mean place for the beginning of the present year is in R.A. 7h. 11m. 31·80s., N.P.D. 113° 6' 19"·4.

THE TOTAL SOLAR ECLIPSE OF 1878.—In one of the handsomely executed volumes which issue from the Government Printing Office at Washington, the U.S. Naval Observatory has published the detailed reports of the various expeditions organised for the observation of the total eclipse of the sun on July 29, 1878, which possess a high degree of interest. A large number of wood-engravings and lithographic plates accompany the reports. There is also appended a brief account of the observations made in California during the total solar eclipse of January 11, 1880.

THE EARTHQUAKE OF NOVEMBER 28, 1880, IN SCOTLAND AND IRELAND[1]

THE data on which the paper has been founded have been collected from upwards of fifty stations, and special reliance may be placed on the results, as a large proportion of these stations were lighthouses, in each of which at the time of the occurrence there was a keeper *on watch*, the earthquake having occurred after sunset at a time when the lamps were lighted.

The paper at the outset gave the effects and nature of the shock experienced by various observers at those lighthouse stations where the disturbance was felt.

The data acquired were then discussed, and the following are the general conclusions arrived at:—

1. That the earthquake occurred in November, a month in which many of the British earthquakes are recorded as having happened.

2. That it occurred after a wet and stormy period, which had been preceded by an unusually dry summer and spring; that there was a widespread thunderstorm at the time, and that the barometer was rising slowly over the greater part of the west of Scotland; the average height of the barometer at the lighthouse stations at which the earthquake was felt being at 9 a.m. 29·4 inches, and at 9 p.m. 29·5 inches. The thermometer at 9 a.m. averaged 50° F., and at 9 p.m. 48° F.

3. That the seismal area was about 19,000 square geographical miles, the shock having been felt as far north as the Butt of Lewis, as far south as Armagh in Ireland, as far east as Blair Athole, and as far west as Barra Head Lighthouse, though how much farther it was propagated into the Atlantic it is impossible to say.

4. That the range of the earthquake or distance to which the wave was propagated was greater over the sea than over the land.

5. That the earthquake was not a simultaneous shake over the disturbed area, but was produced by a wave propagated from a centre.

6. That the undulation seems to have been chiefly of an "up and down" character like a wave of the sea, and that calculating the "breadth" from the mean velocity of transit and the minimum duration of the shock, the wave appears to have been fully 1100 feet "broad."

7. That the observations warrant the assumption that a spot near Phladda Lighthouse (north-east of Colonsay) was the source, and calculating the velocities of transit with a point 13 miles south-south-west of Phladda Lighthouse as a centre, it appears that the wave travelled with a greater velocity over the sea-basin than over the land, probably due to the fact that over the sea there was a thinner and lighter crust to throw into vibration; the average velocity on sea journeys being 6·74 geographical miles per minute, and the average velocity on land journeys 4·65 miles per minute, the mean of the whole being about 5¾ miles per minute.

8. That the source of the earthquake lay at or near the great

[1] By Charles Alex. Stevenson, B.Sc., Edinburgh, communicated to the Royal Society of Edinburgh by Prof. Geikie, F.R.S., March 21, 1881.

fracture of the earth's crust which runs in a south-westerly direction from Inverness.

9. That all the observers who heard the noise agree in stating that it was a "rumbling" sound.

10. That of the fourteen observers within 38 miles of the source who felt the shock, thirteen of them mention having heard the rumbling noise, and none of the other observers in Scotland mention noise as an accompaniment of the earthquake, and hence that the noise was confined chiefly, if not entirely, to places situated near the source.

11. That the stations where the noise was heard were for the most part situated on hard dense rocks, with little or no soil near them.

12. That the average duration of the disturbance was 4·4 seconds for observers situated within the sound area.

13. That of twenty-two lighthouse observers between Cape Wrath and the Mull of Galloway who were situated on the older formations (Laurentian, Cambrian, and metamorphosed Lower Silurian) eleven felt the shock, whilst of thirteen observers situated on newer rocks it made itself known only to two of them, and that the earthquake was therefore more generally felt on the older rocks of Scotland.

14. That stations situated near one another and on the same formation did not necessarily both receive the shock, and that faults and trap dykes did not seem to affect the passage or intensity of the wave in any way.

15. That the observations of time at Armagh, Belfast, and Omagh show that the shocks at these places were most probably propagated direct from Phladda in Scotland, and that the severity of the shock and the "rumbling" noises heard in and around Leterkenny were probably due to a second and local source of disturbance generated by the arrival of the shock from Phladda.

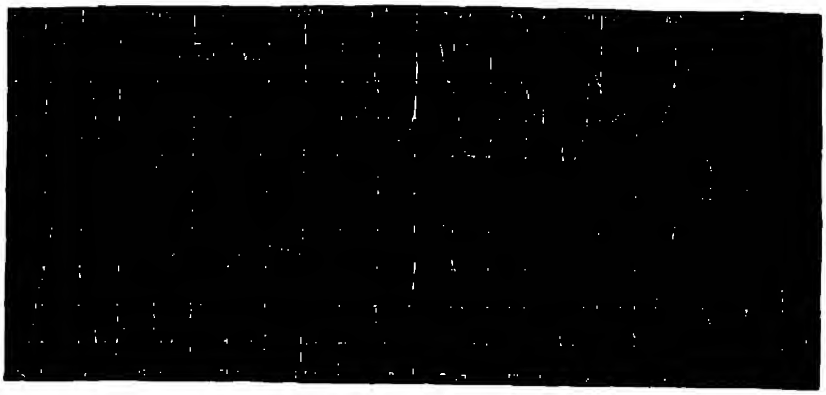
MAGNETIC DECLINATION[1]

1. It is well known that Prof. Rudolph Wolf has endeavoured to render observations of sun spots made at different times, and by different observers, comparable with each other, and has thus formed a list exhibiting approximately the relative sun-spot activity for each year. This list extends back into the seventeenth century, and is unquestionably of much value. Nevertheless it must be borne in mind that we possess no sun-spot data sufficiently accurate for a discussion in a complete manner of questions relating to solar periodicity before the time when Schwabe had finally matured his system of solar observations, which was not until the year 1832.

We have however a much longer series of the diurnal ranges of magnetic declination. Now these are already well known to follow very closely all the variations of sun-spot frequency, being greatest when there are most, and least when there are fewest spots, and it may even be imagined that such ranges give us a better estimate of true solar activity than that which can be derived from the direct measurement of spotted areas.

The long-period inequalities of the diurnal range of magnetic declination are thus, we may imagine, precisely those of solar activity, so that to analyse the former is probably equivalent to analysing the latter.

2. Our method of analysis is not new. The system pursued by us is in fact that which has been pursued by Baxendell, and



probably other astronomers, with observations of variable stars, and it has already been applied by one of us in a preliminary manner to magnetic declination ranges (*Proc.* Lit. and Phil. Society, Manchester, February 24, 1880).

3. The observations at our disposal are those which have been used by Prof. Elias Loomis in his comparison of the mean daily range of the magnetic declination with the extent of the black spots on the surface of the sun (*American Journal of Science and Arts*, vol. l., No. cxlix.). These observations are recorded as monthly means of diurnal declination range, and we found it necessary to multiply each by a certain factor, firstly, on account of the well known annual inequality of declination range, and secondly, to bring them all to the standard of the Prague observations. We have applied for this latter purpose precisely the same corrections as those made by Prof. Loomis.

4. The result of an analysis of these observations has been to indicate the existence of three inequalities: two dominant ones with periods of about 10½ and 12 years, and a subsidiary one with a period of about 16¼ years. By these means we have been enabled to reproduce the observed annual values of declination range with an average difference of 39″. The amount of agreement between the observed and calculated values will be seen from a diagram which accompanies this note. We are however of opinion that the series of observed values at present obtainable is too short to render this analysis a very accurate one. It will certainly not bear carrying back forty or fifty years beyond its starting-point, which was in 1784, and it would be very hazardous to carry it forward any considerable length into the future. We may however mention that our calculations indicate a maximum of declination range about 1884, but not so pronounced a maximum as that of 1871.

5. During our analysis an observation was made by us which we think worthy of record.

It is a well-known fact that the so-called eleven-yearly oscillations of declination range are at certain times large, and at other times small. Thus, for instance, they have been large for the last forty years, but they were small about the earlier part of the present century. It is clear to us from an inspection of the observations that a series of large oscillations is accompanied with an exaltation of the base line, or line denoting average efficiency, while a series of small oscillations is accompanied with a depression of the same. The result is a long period curve of the base line, the beat period, so to speak, of the eleven-yearly inequality.

Now a phenomenon precisely similar occurs in connection with shorter periods. If we take inequalities having a period of three or four months we find that such are alternately well developed or of large range, and badly developed, or of small range, and that a large range of such is accompanied with an exaltation of the base line or line of average efficiency, while a small range is accompanied with a depression of the same. The result is a curve of the base line, of which the period is, roughly speaking, eleven years. May we not therefore imagine that the so-called eleven yearly period, or, to speak more correctly, the

[1] "Note on an Attempt to Analyse the Recorded Diurnal Ranges of Magnetic Declination." By Balfour Stewart, M.A., LL.D., F.R.S., Professor of Natural Philosophy at the Owens College, and William Dodgson. Read at the Manchester Literary and Philosophical Society, March 8.

ten and a half and twelve-yearly periods into which the eleven yearly period may perhaps be analysed, may be in reality beat periods for shorter disturbances? Is it not therefore possible that a study of these shorter periods may give us information regarding the nature of the eleven-yearly period, whether for sun-spots or declination ranges, which the small series of actual observations is incompetent to afford?

We beg to take this opportunity of thanking Mr William Strond for the help he has given us in this investigation

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—At Trinity College the following distinguished graduates of the College have been elected Honorary Fellows — Lord Rayleigh, M A., F.R S, Professor of Experimental Physics, Mr. Henry Sidgwick, M.A, Prælector in Moral and Political Philosophy, the author of "The Method of Ethics"; Mr. Edward Herbert Bunbury, M.A, author of "A History of Ancient Geography," &c, and Mr William Henry Waddington, B.A., Member of the French Institute, late President of the Council, and Minister of Foreign Affairs in France

The Adams Prize is to be given in 1883 for a general investigation of the action upon each other of two closed vortices in a perfect incompressible fluid In particular it is suggested that the case of two linked vortices should be fully discussed, with the view of determining (1) whether any steady motion is possible, and (2) whether any motion can occur in which there are periodical changes in the forms and dimensions of the vortices. Each essay should be accompanied by a full and careful abstract pointing out the parts which the author considers to be new, and indicating the parts which are to be regarded as of more importance than the rest The competition is open to all graduates of Cambridge, essays must be sent in on or before December 16, 1882 Essays must not be written in the candidate's own hand. The successful candidate will receive about 170*l*. He must print the essay at his own expense The examiners are the Vice-Chancellor, and Messrs. A. Freeman, W. H Besant, and E. J. Routh

VICTORIA UNIVERSITY —The following summary of draft regulations on degrees, examinations, and courses of study has been issued:—1 These regulations are, with the exception of certain general proposals with reference to University Matriculation, confined to the subjects of Degrees, Examinations, and Courses of Study in the Faculties of Arts and Science 2. According to the proposals in the Report any certified student of a College incorporated in the University may matriculate at certain times in the year, the definition of College studentship being left to the College or Colleges, subject in each case to the approval of the University. No University examinations leading to a degree will be open to any persons who are not matriculated students 3 According to the proposals in the Report there are to be two distinct Faculties of Arts and of Science The degrees in these faculties are to be those of B A and M.A, B.Sc and M.Sc., and a Doctorate common to the two Faculties and varying as a Doctorate of Literature, of Philosophy, and of Science 4. In consonance with a main principle of the University Charter, the degrees of B A or of B.Sc. are to be conferred upon students who have passed certain prescribed University examinations, and who have attended certain prescribed University courses of study in a College of the University 5. In the examinations for the degrees of B.A and B Sc., and in the privileges conferred by these degrees, a distinction is to be drawn between the Ordinary B A. or B.Sc. degree, and the B A or B.Sc. degree with Honours 6 The regular period of study required of candidates for the degrees of B A and B Sc. is to be three years, of which two shall be after the date of their passing the Preliminary Examination (see § 7 of this summary), but students who have passed the Preliminary Examination (see § 7 of this summary) next in date after their matriculation, and have been placed in the first division of the list of successful candidates, shall be allowed to proceed to their degree in two years 7. All candidates for the degrees of B A. or B Sc. are required to pass a general examination called the Preliminary Examination, and to present themselves for this examination not later than two years from the date of their matriculation Regular first year courses of study are arranged as preparatory for this Examination, to be taken by all students except those who pass it immediately after matriculation (see § 6 above), or who go through the first year's course of one of the Honours Schools approved by the University 8 The subjects of the Preliminary Examination are arranged in two groups (A and B), in one of which every candidate must pass. The essential difference between the two groups is that in A, Latin and Greek are compulsory, but that a choice is given between four subjects, including two modern languages and two elementary sciences; while in B a choice is given between the alternatives of two languages (ancient or modern) and one elementary science, or two sciences and one language (ancient or modern). In B the requirements in modern languages and mathematics are rather greater than in A 9 The other examinations for the degrees of B.A and B Sc will be open to such students only as have passed the Preliminary Examination, and as have attended the prescribed University courses of study in a College of the University These further examinations will differ for students intending to present themselves for an Ordinary B A. degree and for those desirous of a B A. degree with Honours 10 The degree of B A. with Honours is to imply that a student has attended, during three years, prescribed courses of study (approved by the University) in a distinct branch of learning or science forming the subject of one of the Honours Schools of the Faculties of Arts and Science, and that he has passed a prescribed examination in such Honours School after attending its third year's course. The Honours Schools recommended in the Report for immediate establishment in the University are those of (1) Classics, (2) English, (3) History, (4) Philosophy, (5) Mathematics, (6) Engineering, (7) Chemistry, (8) Zoology, (9) Physiology, and (10) Geology, Mineralogy, and Palæontology For all of these Honours Schools the Owens College is prepared to supply classes meeting the proposed requirements of the several Schools 11 The Ordinary degree of B A or B Sc is to imply that a student has attended, during at least two years, prescribed courses of study (approved by the University) forming a connected whole, and that he has passed an examination corresponding to the earlier year's course, to be called the Intermediate Examination, and an examination corresponding to the later year's course, to be called the Final Examination 12. The courses of study, and the corresponding examinations, prescribed for the Ordinary degrees of B A and B Sc, and open to the choice of candidates who have passed either group of the Preliminary Examination, vary according to the predominance in each course (with its examinations) of one branch of learning or science This predominance is not however such as to warrant the maintenance of the designations given (for convenience' sake) in the Draft Regulations of "mainly Classical, Historical, English, Philosophical, Mathematical, Engineering, Experimental Science, and Biological" Candidates for an Ordinary B A. or B.Sc degree may choose any of these groups, but must go through the whole two years' course, and pass both the examinations of the group chosen The examinations and classes however *largely* coincide in particular portions of the several groups. 13 With a view to encourage more advanced study in special branches of learning or science in students whose bent has been determined, or whose capabilities have been developed, at a later stage of their University career, students who have passed the Final Examination for an Ordinary B.A or B Sc. degree, are to be allowed to present themselves for examination for a B A or B Sc. degree with Honours, after attending the third, or second and third, year's Honours Course, only in one of the Honours Schools. 14. The degree of Master of Arts or of Science is to be conferred upon Bachelors of Arts of three years' standing, after not less than six years from the date of their matriculation. B A.s who have graduated with Honours are not to be required to pass any further examination for the M.A degree; those who have taken the Ordinary B A or B Sc. degree are to be required to pass an examination in some portion of one of the Honours Schools Examinations 15. The Doctor's degree in the Faculties of Arts or Science is to be conferred upon M A.s or M.Sc.s who have furnished evidence of special research or learning, to be supplemented when desirable by an examination test.

SCIENTIFIC SERIALS

Bulletin de l'Académie Impériale des Sciences de St. Pétersbourg, t. xxvii., No. 1, February, 1881 —On the results of experiments on the resistance of the air and their application to the solution of problems of firing, by M. Mayevski.—On variations of the fur and on the geographical distribution of the sea-otter (*Enhydris marina*), by M Brandt.—On the integration of partial equations of the first order with several variables whose co-efficients are constant,

by M. Alexéeff.—On the rotation of Jupiter, by M. Kortazzi.—Crystals of beryl from a part of the Southern Oural, by M. Kokscharow.—On the formation of some nitrated derivatives of some hydrocarbons of the fatty series by direct action of nitric acid, by M. Konowalof.—On the variability of forms of *Lubomirskia Baicalensis*, and on the distribution of sponges of Lake Baikal, by M. Dybowski.—On universal time, and on the choice for this purpose of a prime meridian, by M. Struve.—Anatomy of the lactiferous glands during the period of lactation, by M. Saefftigen.—On the spectroscopy of hydrogen, by M. Hasselberg.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti, vol xiv fasc 4 (February 24).—On a method of finding with the microscope the adulterations of the more common varieties of farina, by Dr Cattared.—Experimental researches with the Crookes' apparatus, by Prof. Ferrini.—On a quadratic Cremonian correspondence between the elements of two fundamental forms of the fourth species, or ruled spaces, by S. Aschieri.—Considerations on new species of partial blindness in Arachnida, by Prof. Pavesi.

Fasc. 5.—Materials to serve for the study of *Peronospora viticola*, by Count Trevisan.—On primary and secondary psoitis, by Prof. Sangalli.—The sanitary administration in Spain, by Dr. Quechi.—Determination of the maximum moments due to weights linked on a supported beam, by Prof. Clericetti.—On an abnormal case of fructification in Florideæ, by S. Ardissone.

Revue Internationale des Sciences, February, 1881.—Prof. Vulpian, physiological study of poisons, vii. Curare (end).—Prof. R Lankester, embryology and classification of animals.—Fernand Lataste, a few more words on the fecundation of the urodele batrachians.—Notices of learned societies.—Belgian Academy (abstract of Van Bambeke's paper on the formation of the embryonic lamellæ and the notochord in the urodela).—Paris Academy. on the appointment of M. Bouley to the Chair of Comparative Pathology at the Natural History Museum, Paris.

Journal de Physique, March.—On the division of instantaneous currents (continued), by M Brillouin.—On the psychrometer, by M Angot.—New tourmaline pincer, by M Bertin.—Constitution of the flame of the Bunsen lamp, and some modifications in the construction of this lamp, by M Terquem.—On some experiments in acoustics, by M. Neyreneuf.

Atti della R. Accademia dei Lincei, vol. v. fasc 7 (March 6).—On solar observations at the Royal Observatory of the Roman College in 1880, by P Tacchini.—Observations of comets and planets at the same college with the Merz equatorial, during 1880, by the same.—M. Janssen's solar photographs taken at Meudon Observatory, by the same.—Thermal laws of the exciting spark of condensers, by E. Villari.—On sodio-ammoniacal trimolybdate, by F. Mauro.—Studies on rotatory power, by R. Inasinio.—On some compounds of the pyrolic series, by L. G. Ciamician.—On the electrophorus, by G Govi.—On pathological bases, by F. Selmi.—On the causes of distinctness in solar photographs, by S. Respighi.—On experiments made at the Observatory of Campidoglio for determination of gravity, by the same.

Sitzungsberichte der naturwissenschaftlichen Gesellschaft Isis in Dresden (1880).—A modern investigation of the flora of Saxony, by Prof Drude.—On the Pycnodontidæ, especially the genus Gyrodus, by Prof Vetter.—The Nudibranchia of the sea, by Herr Blaschka.—On the determination of fixed points of normal mercury thermometers and the measurement of temperatures, by Prof. Neubert.—On various finds in the neighbourhood of Dresden, by Dr. Caro.—Hydroid medusæ or Craspedotes, by Herr Blaschka.—Progress of geological researches in North America, by Dr. Geinitz.—On plant-remains from the Tertiary formations of Liebolitz and Putschein, by Herr Engelhardt.—Observations on the growth of the leaf of *Victoria regia*, Lindl., in the Dresden Botanical Gardens in 1880, by Prof Drude.—The Slav and German immigration into Saxony, by Prof. Meitzen.—The urn-field of Persia, by Herr Wiechel.

Archives des Sciences Physiques et Naturelles, No. 3, March 15. Swiss geological review for 1880 (continued) by M. Favre.—Considerations on the study of phyllotaxy, by M. de Candolle.—Notice of researches by Drs. Tenchini and Staurenghi, on the anatomy of the human cerebellum.

Rivista Scientifico-Industriale, No. 5, March 15.—On Reese's fusing disk, by Prof. Bombicci.—Volta's pile rendered constant and depolarised, by Count Mocenigo.

SOCIETIES AND ACADEMIES

London

Royal Society, March 31.—On the coefficients of expansion of the iodide of lead, and of an alloy of iodide of lead with iodide of silver, by G F. Rodwell, Science Master in Marlborough College.

The iodide of lead was examined by the special means described by the author in former communications to the Society, and was found to possess three coefficients of expansion. Between 0° and 205° C the coefficient of cubical expansion for 1° C. is ·00007614, increasing to 00008307 between 205° and 253° C

Between 253° and 265° C. the mass expanded very rapidly, with a coefficient nearly eight times greater than the preceding, viz ·0006378. After the subsidence of this rapid expansion the coefficient became ·000180. The volumes of the iodide between 0° and the fusing point (383° C) are given, and are shown in a curve-table.

Iodide of lead was fused with iodide of silver in such proportions as to form an alloy containing one molecule of each constituent, viz. PbI_2, AgI. This contains 66·20 per cent of iodide of lead, and 33 80 per cent. of iodide of silver. The melting-point of the alloy was found to be 350° C, the specific gravity 5 912 On heating it was found to expand under a very low coefficient between 0° and 118° C, then it neither expanded nor contracted while heated through 6° C, at 124° C it commenced to contract, and underwent between 124° and 139° C as much contraction as iodide of silver itself, again it was stationary for 5° C., and at 144° C. it began to expand again, with a much higher coefficient than it possessed between 0° and 118° C.

The following are some noticeable points about the alloy:—

1 It possesses similar densities at three different temperatures

2. Although it contains only 33 8 per cent. of iodide of silver it contracts as much during heating as the iodide of silver itself.

3 While the iodide of silver commences to contract at 142° C., and terminates at 145°·5 C, the alloy commences to contract 18° C. lower, and terminates its contraction 6° 5 C. lower

4. The harsh sounds emitted during the cooling of the alloy, and the tremors simultaneously propagated through its mass, prove that violent molecular agitation is taking place while the iodide of silver is passing from the amorphous plastic condition, into the brittle crystalline condition within the mass of, or surrounded by the molecules of, the iodide of lead

5 The fusing point of the alloy is 33° lower than that of the iodide of lead, which constitutes two-thirds of its weight, and 177° lower than that of the iodide of silver, which constitutes one-third of its weight.

6. And if this is due to the fact that similar particles of matter attract each other more powerfully than dissimilar, and hence that when the particles of two bodies are mutually diffused the attraction becomes less than that of the molecules of either one of them singly, and the molecular motion is hence more easily assimilated, the same cause may explain the commencement of the phase of contraction on heating the alloy at a temperature 18° C. lower than that of the iodide of silver to which it owes this property.

7. If we compare one of the chlorobromiodides of silver, before described by the author (*Proc.* Roy Soc., vol. xxv. p. 295) with the lead-silver iodide alloy, some curious anomalies present themselves. The alloy, AgI, AgBr, AgCl (lately also discovered as a mineral), contains 41 484 per cent. of iodide of silver, and 58·516 per cent. of the chloride and bromide of silver (which from an expansion point of view may be regarded as the same substance, because their co-efficients are practically the same). But although the mean coefficients of expansion of the chloride and bromide scarcely exceed those of the iodide of lead, and although the chlorobromiodide contains 8 per cent. more iodide of silver than the lead-silver iodide alloy, the amount of *contraction* by heat of the latter is more than twenty times greater than that of the former, although we must believe this effect to be solely due in each case to the presence of the iodide of silver.

Mathematical Society, April 14.—S Roberts, F.R.S., president, in the chair.—The chairman briefly, but feelingly, alluded to the loss the Society had sustained by the recent death of Mr. T. Cotterill, M.A., formerly Fellow of St. John's College, Cambridge, who was for many years a member of the Council, and had always taken a warm interest in the Society.

—The following communications were made:—On the geodesic curvature of a curve on a surface, Prof. Cayley, F.R.S.—On operative symbols in the differential calculus, Prof. Crofton, F.R.S.—Note on the resolution in factors of numbers differing but slightly from π, Mr. J. W. L. Glaisher, F.R.S.—On the nature of the quadric represented by the general equation of the second degree in tetrahedral co-ordinates, and on the five focal quadrics of a cyclide, Mr. H. Hart, M.A.—The discrimination of the maximum or minimum path of a ray of light reflected at a given curve, Mr. H. M. Taylor, M.A.—On certain tetrahedra specially related to four spheres meeting in a point, and historical note on Dr. Graves's theorem on confocal conics, the President.

Physical Society, April 9.—Prof. W. G. Adams in the chair.—Prof. Helmholtz was elected an honorary member of the Society, and Dr. James Moser an ordinary member.—Dr. J. H. Gladstone read a note on thermal electrolysis, by himself and Mr. Alfred Tribe. The authors found that when sheet-silver was plunged into fused silver chloride or iodide of silver crystals of silver formed on the sheet. When copper was immersed in fused cuprous chloride copper crystals deposited on it, and when zinc was placed in melted zinc chloride or iron in melted ferrous chloride, these two metals crystallised on the plates. They found this to be due not to a difference in the physical condition of the rolled metals, but to the unequal heating of the different parts of the immersed metals. By the contact theory of voltaism there will be a difference of potential between the metal and the liquid chloride in contact with it, and this difference of potential will vary with temperature. Since all parts of the immersed metal cannot be supposed at the same temperature always, there is the possibility of a current being set up and consequent electrolysis of the salt. This view was corroborated by heating the metal unequally, when a crop of crystals appeared in the cooler part of the liquid. Again, two silver rods connected together were plunged, the one in a hotter, the other in a cooler part of fused silver chloride, and at the end of fifteen minutes the latter was studded with crystals of silver, whilst the former was clean. A galvanometer showed a stronger current between the rods, the greater the difference of temperature between the parts of the fluid in which they were placed, and transposing the rods reversed this current. These experiments bear on the nature of voltaic action, and form a lecture illustration of the conversion of heat into electricity and chemical force. Mr. W. H. Walenn stated that he had found when zinc is immersed in an electro-brassing solution, crystals of brass (*i.e.*, zinc and copper) were deposited on it.—Capt. Abney exhibited a number of photographic negatives taken by himself and Col. Festing, by radiation through thin sheets of ebonite. The light from the positive pole of an electric lamp was sent through a thin sheet of ebonite $\frac{1}{32}$ inch thick, and photographs taken showed the radiation to have a low wave-length, from 8000 to 14,000. The carbon points of the lamp could be photographed through the sheet, and Col. Festing observed the sun's disk through it. The ebonite showed a grained structure, and different samples of ebonite gave different results, but all gave some result in course of time at least; old ebonite, like that used in some of Mr. Preece's experiments, scattering the light more than new ebonite.—Dr. Moser exhibited the passage of the rays through the ebonite to the audience by means of a galvanometer. Prof. Guthrie observed that Capt. Abney had proved that light as well as heat traversed the ebonite, and Dr. Coffin stated that the composition of ebonite apparently the same might vary considerably, and hence its radiant transparency might vary too.—Prof. Helmholtz addressed the meeting on the localisation of objects by the eyes. We estimate distance with one eye by the outlines of the more distant objects being covered by the nearer ones where they meet, and by the shadows thrown by the anterior objects. These conditions are very rarely overpowered by others, as, for instance, binocular vision. This is shown by Dove's pseudoscope and the fact that closing or blinding one eye makes little difference to the power of judging distance, especially when not very close to the eye. The relative shifting of objects, as the eye is moved from side to side, or to and fro, or up and down, which may be called the parallax of motion of the head, is also a strong factor in estimating distance. The author had concluded from a study of the stereoscope that the perception of the absolute convergence of our eyes is very indistinct, and that only differences of convergence related to apparently near or distant objects produce the stereoscopic effect. Recent observations of his show that the incongruity between the degree of convergence and the parallax of motion is perceived with great accuracy. Dr. Stone remarked that a person suddenly blinded in one eye acquires a new judgment of distance by moving the head (a habit seen in nocturnal birds), and in taking certain French stereoscopic pictures the camera is shifted to another point, so that the combined images produce an impression of smallness in the object. These facts corroborated Prof. Helmholtz's view; and Mr. Lewis Wright pointed out that santonin, which changes the sense of colour, also appears to change the sense of distance, perhaps by relaxing the muscular sense.

Geological Society, April 6.—J. W. Hulke, F.R.S., vice-president, in the chair.—Edward F. Boyd, Lieut. Herbert de Haga Haig, R.E., J. C. Margetson, Edward David Price, and James Tonge were elected Fellows of the Society.—The following communications were read:—The microscopic characters of the vitreous rocks of Montana, U.S., by F. Rutley, F.G.S., with an appendix by James Eccles, F.G.S.—On the microscopic structure of devitrified rocks from Beddgelert, Snowdon, and Skomer Island, by F. Rutley, F.G.S.—The date of the last change of level in Lancashire, by T. Mellard Reade, C.E., F.G.S. The author described some observations made by him at Blundellsands, on the coast of Lancashire, near Liverpool, according to which, judging from the position of high water mark, the land had gained considerably upon the sea between 1866 and 1874. The author adduced evidence in support of his view, and concluded that if the last change of level in South-West Lancashire was a downward one it could not have taken place within 2500 years.

Institution of Civil Engineers, April 5.—Mr. Brunlees, F.R.S.E., vice-president, in the chair.—The paper read was on the actual lateral pressure of earthwork, by Mr. B. Baker, M. Inst. C.E.

EDINBURGH

Royal Society, April 4.—Prof. Balfour in the chair.—Prof. Tait communicated the results of his experiments on the pressure errors of the *Challenger* thermometers, the correction for which, as originally furnished to the expedition, was 0°·5 F. per mile of depth. The mode of experimenting was to subject the thermometers to considerable pressure in a hydraulic press, which was essentially a strong steel cylinder that was warranted to stand a pressure of 25 tons weight on the square inch. It was supported in an upright position upon a strong tripod stand. Water was filled in from above; and into the upper end of the cylinder there was lowered a tight-fitting plug which was fixed in position by a transverse steel bolt. The lower end of the cylinder was connected through a narrow copper tube to a hydraulic pump, which, by pumping in water to the cylinder, raised the pressure to the required amount. At three tons pressure an average effect of 1°·5 F. was produced upon the inclosed thermometers. Before drawing any conclusions as to the correction to be applied in deep-sea sounding, it was necessary to consider how far this effect could be explained as resulting from the peculiar conditions under which the experiments were made. From the known compressibility of glass it was calculated that the volume of the bore of a thermometer tube, closed at both ends, would be diminished by only one-thousandth part for an increase of pressure of one ton weight on the square inch; and from a direct experiment made with a metre-long tube this was proved to represent very approximately the real effect. Hence it was quite out of the question that this could have any appreciable effect on such comparatively short thermometers as those of the *Challenger*, which were besides subject to much graver errors, such as those arising from the shifting of the indices during the ascent from the depths, or even from the effect of parallax when taking the reading. The direct action of pressure may then be disregarded, and the effect produced upon the thermometers in the compression apparatus must be due to secondary effects of pressure, such as evolution of heat. The various sources of heat were four: 1. Heating of the water by compression. This depends greatly on the original temperature of the water, being *nil* at the point of maximum density (40° F.), and larger for higher temperatures. One-fourth of the total effect is due to this. 2. Heating of the water due to pumping in through the narrow tube. This accounts for three-twentieths of the effect. 3. Heating of the vulcanite frame by compression. This explains another fifth. 4. Heating due to the effect upon the protecting bulb. This probably explains the remaining two-fifths of the effect. In this last case however there is not only compression, but distortion; and of the thermal effects of such a strain no one yet knows anything. These four sources of error

cannot be supposed to exist under the conditions in which deep-sea temperatures are taken; and the only other possible source, that namely due to the direct effect of pressure, gives rise to an error which requires a correction of only 0°·04 F. per mile of depth. In the course of the description of experiments Prof. Tait had occasion to describe the various kinds of pressure gauges which he had found it necessary to devise, the ordinary forms of gauge being altogether useless for scientific work.—Mr. W. W. J. Nicol read a paper on the action of heat on thioformanilide, being an account of experiments he had made in Prof. Hoffman's laboratory at Berlin during the preceding winter.—Mr. Patrick Geddes read the second instalment of his scheme for the classification of statistics. In it he discussed the arrangement of statistics relating directly to the organisms of the society. Three great parallel classes, A, B, C, were formed: A being concerned with the *source* of the organisms forming a community as arising from survival, immigration, and birth; C with the *loss*, from emigration and death; while B contained the biological and social characteristics of the individuals forming a community at any given instant of time. Classes A and B formed the one side and C the other side of the social balance sheet. In treating of occupations the same three classes appeared again: A dealing with operations on matter and energy, B with services rendered to society (including education, government, &c.), and C forming the class of the essentially unproductive, *e.g.* the unemployed, the disabled, the destructive, &c. The question of partition, both mediate and ultimate, amongst the organisms of matter and energy fell next for discussion, and this led on to the final classification of uses made after partition, in all of which it was shown that the classification fitted naturally into the three original classes, A, B, and C, indicated above. In a future paper Mr. Geddes hoped to demonstrate the *practical* value of his system.

Vienna

Imperial Academy of Sciences, April 7.—L. Fitzinger in the chair.—The following papers were read:—Dr. G. Becka, on the orbit of the "Ino" planet (No. 173).—Dr. E. Ludwig, on a new method for the quantitative determination of uric acid.—Dr. D. Dublier, on the influence of continual use of carbonate of soda on the composition of the blood.—Dr. James Moser, electrostatic investigations especially into the ramification of induction on the differential inductometer and electrophorus.—Dr. Moritz Holl, on the blood-vessels of the placenta of man.—L. Haitinger, on nitro-olefines.

Imperial Institute of Geology, March 15.—E. Kittl, on a recent find of Listriodon (found at Nussdorf, near Vienna, in 1879).—Dr. E. Mojsisowics, on the cephalopod fauna of the Triassic formations at Mora d'Ebro, in Spain.—K. M. Paul, on the occurrence of ozokerite and petroleum at Boryslaw (Gallicia).

April 5.—E. Kittl, on Bohemian spas.—Baron H. Fullon, observations on crystallisation.—Dr. V. Hilber, on the terminal stratifications of gypsum in Eastern Gallicia.

Paris

Academy of Sciences, April 11.—M. Wurtz in the chair.—The following papers were read:—On peroxide of ethyl, by M. Berthelot. This may be prepared by sending through anhydrous ether, for several hours, a slow current of quite dry and strongly ozonised oxygen. The formation of oxygenated water by action of ozone on ether is not immediate, but by destruction of a first compound, viz. peroxide of ethyl. This substance is a sesqui-oxide $C_{16}H_{20}O_6$.—On the Eulerian integral of the second species, by M. Gyldén.—Researches on the liquefaction of gaseous mixtures, by MM. Cailletet and Hautefeuille. Operating with a gas easily liquefiable and a so-called permanent gas, in capillary tubes, total liquefaction (yielding a homogeneous liquid) is obtained by first compressing the mixture at a temperature so high that the strongest pressures prove powerless to abolish the gaseous state, then lowering the temperature regularly, so that all points of the tube pass at the same time through the temperature at which is produced a change of state. The authors thus obtained condensed carbonic acid, holding a large proportion of oxygen, hydrogen, or nitrogen, these latter substances concurring to form the liquid, though the temperature was too high for them to exist separately in that state. The results of experiment with cyanogen and carbonic acid are analysed. The assimilation (generally very imperfect) of solution of a gas to its liquefaction probably here applies. The mixture retains its characters at temperatures considerably above that corresponding to the critical point of its less easily liquefied element.—On the lines of iron in the sun, by Mr. N. Lockyer. He shows reason for believing that iron does not exist in the heart of the sun, but only its constituents, and these exist at different levels in the sun's atmosphere and produce more complex forms by condensation.—On pucerons attacked by a champignon, by MM. Cornu and Brongniart. The insect belongs to the cycle of development of *Tetraneura rubra*, which produces the red galls of elm. The fungus is a *Pleospora*; it attacks the dead puceron. It is probably incapable of affecting much the multiplication of phylloxera.—On the integration of linear equations by means of Abelian functions, by M. Poincaré.—On formulæ of representation of functions, by M. du Bois-Reymond.—Study of the vapour of bisulphydrate of ammonia, by M. Isambert. The substance is less volatile in presence of its elements than *in vacuo*, or in an inert gas such as hydrogen.—On chlorides, bromides, and iodides of sulphur, by M. Ogier. A thermo chemical study.—On the development of *Triænophorus nodulosa* or *Triænophorus nodulosus* of Rudolph, and on its cysticercus, by M. Megnin. The perches of the Seine are greatly affected by this parasite at present.—Studies on some points of the anatomy of *Sternaspis scutata*, by M. Rietsch.—On the different species of bears whose remains are buried in the cavern of Lherm (Ariège), by M. Filhol. Remains of an enormous *Ursus arctos* (apparently) have been found among about 100 bones of *Ursus spelæus*. M. Filhol doubts the descent of the former bear from the latter. He supposes that *Ursus arctos*, appearing in distant regions (perhaps North America), gradually advanced and was substituted in our countries for *Ursus spelæus*. Bone fragments of a new type of bear have been found in this cave. The author names it *Ursus Gaudryi*. The fossil femur of an enormous lion has also been found.—Production of a hydrated silicate of baryta in crystals, by M. Le Chatelier. This appears on the inner surface of vessels of baryta water left standing uncleaned a long time.—On the production of a crystalline phosphide of iron and of anorthite felspar in the fires of the Commentry coal pits, by M. Mallard.—On the swelling of the Seine during the winter of 1881, by M. Lemoine. The Seine at Paris has been pretty high from the middle of January to the middle of March. Usually (as M. Belgrand has shown) the maximum of flood at Paris is due to the waters of small torrential rivers mostly in the upper part of the valley and issuing from impermeable strata. But last winter, it is chiefly the rivers nearest Paris, those of Brie, that, by their quite unusual swelling, have brought on the maximum (which has therefore come with great rapidity). The subsoil of La Brie is like a sponge, and when it is gorged with water the least rain causes important floods.

CONTENTS

THURSDAY, APRIL 28, 1881

SCIENTIFIC WORTHIES

XVII.—ROBERT WILHELM BUNSEN

THE value of a life devoted to original scientific work is measured by the new paths and new fields which such work opens out. In this respect the labours of Robert Wilhelm Bunsen stand second to those of no chemist of his time. Outwardly the existence of such a man, attached, as Bunsen has been from the first, exclusively to his science, seems to glide silently on without causes for excitement or stirring incident. His inward life however is on the contrary full of interests and of incidents of even a striking and exciting kind. The discovery of a fact which overthrows or remodels our ideas on a whole branch of science, the experimental proof of a general law hitherto unrecognised, the employment of a new and happy combination of known facts to effect an invention of general applicability and utility; these are the peaceful victories of the man of science which may well be thought to outweigh the high-sounding achievements of the more public professions.

Prof. Bunsen is eminently a soldier of science, his devotion to his flag has been unwavering and life-long, and his whole existence has been a noble struggle for the mastery of nature's secrets. Born on March 31, 1811, at Göttingen, where his father was Professor of Theology, Bunsen graduated in that ancient University before he had passed through his teens, and published an inaugural dissertation, "Enumeratio ac descriptio hygrometorum." Soon afterwards, at the age of twenty-two, he became a privat-docent at the university of his native town, thus entering the career of a teacher, which he has consistently followed with conspicuous success for close on half a century. In 1836 Bunsen became Professor of Chemistry at the Polytechnic School in Cassel, in 1838 he was appointed to the Chair of Chemistry in the University of Marburg, where he remained for thirteen years, afterwards he was for a short time at Breslau, whence he removed to Heidelberg, of which renowned University he has been one of the chief ornaments and attractions for the last thirty years.

Bunsen's first scientific investigation was one which attracted general attention, and the results of which are of permanent importance. In conjunction with Berthold, a colleague at Göttingen, he showed that moist freshly precipitated ferric hydroxide acts as a certain antidote in cases of poisoning by arsenic, provided that it is exhibited in sufficient quantity and early enough in the history of the case. The explanation of this action is the formation of an insoluble ferrous arsenite; 100 parts of the dry hydroxide carry down from five to six parts of arsenic. So well known and valued is this antidote in Germany, that it is kept by apothecaries ready for use.

In 1835 Bunsen described some singular compounds which the double cyanides form with ammonia. He contradicted the general statement that ammonium ferrocyanide is formed by boiling prussian blue with ammonia; but showed that it is formed by digesting lead ferrocyanide with ammonium carbonate. He also measured the angles of crystals of many of the double cyanides.

In 1837 he struck the first note of one of his most important and fruitful investigations in a memoir on the existence of arsenic as a constituent of organic bodies. In the year 1760 the French chemist Cadet had observed that a mixture of acetate of potash and white arsenic yields, when heated, a heavy brownish-red liquid, which has a frightful smell and fumes strongly in the air, and this liquid was termed Cadet's fuming arsenical liquid. Little more than the fact of its existence was ascertained concerning this body until Bunsen undertook its examination, and in a series of memoirs which have now become classical, and which extended over many years, placed its composition in a true light, thus giving to the world the first member of the now well-known family of the organo-metallic bodies.

Bunsen showed that Cadet's liquid, as well as its numerous derivatives, contains a radical having the formula C_2H_6As, and that this substance in its chemical relations exhibited striking analogies with a metal, being indeed, as he terms it, "a true organic metal." He succeeded in isolating this body, and this discovery formed not only the starting-point for the preparation of hundreds of other similar bodies, but also contributed largely to the development of one of the most important of our chemical theories, that of compound radicals. This body, like most of its compounds, possesses a most offensive odour, so much so that the air of a room containing a trace of the vapour is rendered absolutely unbearable. Hence to this substance Bunsen gave the name of Cacodyl (κακώδης, a bad smell). Not only however are these compounds unpleasant, but they are highly poisonous, very volatile, dangerously explosive, and spontaneously inflammable. It is difficult enough nowadays for a chemist to work with such substances armed as he is with a knowledge of the danger which he has to encounter, as also with improved appliances of every kind to assist him in overcoming his difficulties. But Bunsen forty years ago was a traveller in an unknown and treacherous land, without sign-posts to guide him, or more assistance on his journey than was furnished by his own scientific acumen and his unfaltering determination. Nor did he escape scot-free from such a labour, for in analysing the cyanide of cacodyl the combustion tube exploded, Bunsen lost the sight of an eye, and for weeks lay between life and death owing to the combined effects of the explosion and the poisonous nature of the vapour. "This substance," he writes, "is extraordinarily poisonous, and for this reason its preparation and purification can only be carried on in the open air; indeed, under these circumstances it is necessary for the operator to breathe through a long open tube so as to ensure the inspiration of air free from impregnation with any trace of the vapour of this very volatile compound. If only a few grains of this substance be allowed to evaporate in a room at the ordinary temperature, the effect upon any one inspiring the air is that of sudden giddiness and insensibility, amounting to complete unconsciousness."

Taking a totally different direction, Bunsen's next important investigations were concerned with the examination of the chemical changes which occur in the blast-

furnace In 1838 he proved, by accurate analyses of the gases escaping, "that at least 42 per cent of the heat evolved from the fuel employed is lost, and that in view of the ease with which such combustible gases can be collected and led off to a distance for subsequent use, a new and important source of economy in the iron manufacture is rendered possible." This research is however not only noteworthy as pointing the way to a method of economical working without which probably but few iron-masters at the present day could exist, but also as being the first experiment in which an accurate method of gas-analysis was employed This important branch of analytical chemistry has been created and brought to its present wonderful degree of precision solely by the head and hands of the Heidelberg experimental philosopher Simplicity and accuracy constitute the rare merits of Bunsen's system of gaseous analysis. To have gone completely through his course of gas analytical manipulations from the sealing-in of the platinum wires in the eudiometer to the absorption- and explosion-analyses of the Heidelberg coal-gas, under the eye and with the guiding help of the hand of the master, is in itself an experimental education of no mean order But it is only on reference to his "Gasometric Methods" that we learn the general adaptability of this marvellously accurate system to all those numerous problems in which the analysis of a mixture of gases is required.

Next in order (1841) comes the invention of the Bunsen battery, an invention which has proved of the greatest practical value to mankind, inasmuch as this form of battery is now very largely used all over the world, not only as a scientific instrument, but also for ordinary telegraphic purposes. The chief point in this invention consists in the employment of carbon as the negative pole in place of copper or platinum In his first communication on this subject, Bunsen accurately measures the absolute intensity of the current from his zinc-carbon battery, and compares it with that of a Grove (zinc-platinum) battery, invented a short time before by Sir William Grove.

Bunsen's next great achievement consists in the investigation from both the chemical and the physical point of view of the volcanic phenomena of Iceland. The several memoirs on this subject are the result of a visit to Iceland in 1847. They consist, in the first place, of a careful and extended series of analyses giving the average composition of the volcanic rocks of different ages occurring in the island, upon which he founded a most important and very general theory of volcanic action, a theory which he has since proved is applicable to the formation of other volcanic rocks of widely different origin, both as regards time and locality This theory consists, to begin with, in a proof that all the Islandic rocks, of whatever age, may be considered as mixtures in varying proportions of two normal silicates, the trachytic and pyroxenic In the first of these (an acid silicate) the relation of the oxygen of the acid to that of the bases is as 3 · 0·596, whilst in the latter (a basic silicate) the relation is as 3 · 1·998 This result, accompanied by an experimental proof that the melting-point of different bodies is differently raised under increase of pressure, led Bunsen to assume that a crystallisation of these two normal silicates occurs in the earth's interior, and that all the eruptive rocks which reach the surface consist either of one or other of these or of mixtures of the same In the next place they contain a full and successful research on the so-called pseudo-volcanic phenomena of Iceland, in which he investigates the formation of zeolites and other crystalline minerals by the joint action of heat, acid gases, and moisture on the volcanic rocks He also examines the composition of the fumerolle gases as well as those issuing from the crater of Hecla, and explains the nature of the changes effected by these gases on the surrounding rocks. Lastly, he investigates the far-famed Great Geyser, and places the cause of the periodic eruption of boiling water on its true physical basis. His accurate observations on the spot, first as to the construction of the geyser-tube, then as to its mode of formation, and finally, his thermometric measurements of the temperature of the water-column taken a few moments before the eruption and at different depths, disposed once for all of what may be called the old tea-kettle theory, and showed indisputably that in no part of the tube did the water reach the temperature of ebullition under the pressure of the superincumbent column, whilst the column is quiescent, but that when the geyser column is elevated by the rush of steam from the volcanic vents at the bottom, the boiling-point of the water at each point of the column thus raised is reached, and "the whole mass from the middle downward suddenly bursts into ebullition, the water above mixed with steam-clouds is projected into the atmosphere, and we have the Geyser eruption in all its grandeur By its contact with the air the water is cooled, falls back into the basin, partially refills the tube in which it gradually rises, and finally fills the basin as before Detonations are heard at intervals, and risings of the water in the basin These are so many futile attempts at an eruption, for not until the water in the tube comes sufficiently near its boiling-point to make the lifting of the column effective can we have a true eruption" (Tyndall)

To do justice to all the contributions with which Bunsen has enriched our science would fill several numbers of NATURE, and to many of them the writer must content himself with a mere cursory reference One of his favourite and fruitful themes was the preparation by electrolysis of the rarer or more difficultly procurable metals This is one of the purposes for which he employed his battery. Metallic magnesium was one of the first of his preparations of this kind, and in the description of this preparation his fertility of resource is clearly seen Metallic magnesium in the molten state is specifically lighter than the fused mixture of salts from which it is obtained Hence as soon as a globule of the metal is formed, it rises to the surface, and there takes fire and burns To obviate this difficulty the carbon pole on which the metal was formed was serrated, and the metal on rising was caught, below the surface of the fused salt, in one of a series of small pockets, and thus prevented from burning.

Then followed the reduction of chromium, aluminium, and, in conjunction with the late Dr Matthiessen, that of the alkaline-earth metals, and more recently with Hillebrand and Norton, of the metals of the cerium, group. These electrolytic researches are marked with the thoroughness and completeness which is characteristic

of all Bunsen's work He seeks for the explanation of the fact that hitherto the reduction of these metals by the electric current had proved a failure, and he finds it in what he terms the density of the current, *i.e.* the electromotive force divided by the area of the pole, the power of the current to overcome chemical affinity increasing with its density Thus if a constant current be led through an aqueous solution of chromic chloride, the result as to whether hydrogen is evolved, and oxide of chromium, or whether metallic chromium is deposited, depends upon the area of the pole through which the current passes into the liquid

Nor were these experiments made merely for the purpose of preparing the metals in question. Thus the metallic magnesium was pressed into wire and used in one of the series of photo-chemical researches, to which reference will hereafter be made, for the purpose of drawing an interesting conclusion respecting its light-giving power on combustion, and comparing this with the visual and chemical brightness of the sun, a comparison which led to the commercial manufacture of this metal by the Magnesium Metal Company, and to the wide distribution and general use of this metal as an illuminating agent of great brilliancy Thus again the electrolytic preparation in the Heidelberg laboratory of coherent masses of cerium, lanthanum, and didymium, had the further object of the determination of the specific heat of these metals by help of the now well-known method with Bunsen's ice-calorimeter, by means of which determination the true atomic weights of these metals and the proper formulæ of their oxides and compounds have been definitely ascertained

The Bunsen battery has however not only been of service in inorganic chemistry, but has thrown clear light upon the constitution of organic bodies The classical researches of Kolbe on the electrolysis of acetic acid and the other fatty acids were carried out in the Marburg laboratory, and owe their inspiration to Bunsen The subsequent equally important labours of Kolbe and Frankland, and those of the latter chemist alone, on the isolation of the organic radicals, have a like origin

Amongst the numerous physico-chemical investigations which Bunsen has carried out, none perhaps show more clearly the fertility of his experimental ability than the one in which he describes the ice calorimeter, and another devoted to an explanation of a new method of determining vapour densities. Translations of these memoirs are found in the *Philosophical Magazine* for 1867 and 1871, and may be taken as typical of his calorimetric researches.

Another group of researches is formed by those which are closely related to his gasometric methods. One of the most interesting and important of these refers to the law of absorption of gases in water. This subject was first examined by Dalton and Henry at the beginning of the century, and the well-known law which gases follow in absorption is known by the names of these two Manchester philosophers. But although generally admitted, its limits of error had not been ascertained, and the crude experimental methods of the year 1803 required to be replaced by the refined ones of the latter half of the century. These researches, carried on by Bunsen and by several of his pupils, proved that Henry's law of direct—as well as that of Dalton of partial—pressures is exactly true within certain limits; but ceases to be so beyond a given increase of pressure, whilst some gases which obey the law at one temperature do not do so at others, and some again whilst obeying it in the pure state, do not do so when mixed with other gases

The mere mention of his other researches in the wide field of gaseous chemistry is sufficient to indicate his devotion to this branch of experimental inquiry. We find experiments on laws of gaseous diffusion, on applications of gaseous diffusion in gasometric analysis, on the phenomena of the combustion of gases, on the temperature of ignition of gases, and all these, be it remembered, involving exact measurement, and in many cases elaborate calculations.

Brief reference must next be made to a series of investigations in a totally different direction, viz on the measurement of the chemical action of light, with the carrying out of which the writer of this article had the great good fortune and pleasure to be connected, and in which he had full opportunity of admiring Bunsen's untiring energy and wonderful manipulative power. In all the difficulties and perplexities by which the experimental investigation of such a subject is beset, the writer never knew Bunsen discouraged or at a loss for an expedient by which an obstacle could be overcome. Cheerful and self-reliant under the most depressing circumstances, he never gave up hope, and thus it was that these somewhat intricate and difficult investigations were brought to a successful close.

Again, in the department of Analytical Chemistry how numerous and valuable have been his contributions! There is scarcely one important problem in this subject which has not benefited from his extensive experience and keen insight Bunsen's methods of silicate analysis, of mineral water analysis, and a dozen of other complicated laboratory processes, are simply perfect. Then his original method for the estimation of nitrogen in organic bodies will always be remembered as one of the most accurate of its kind when employed by an experimentalist as expert as Bunsen himself, but as most difficult and even dangerous in less able hands Again, all chemists use and appreciate the much simpler methods for the estimation of nitrogen and sulphur admirably worked out by his pupils—Maxwell Simpson and Russell

We all employ his beautiful general method of volumetric analysis, but chemists do not always remember that in this research Bunsen first determined the exact percentage composition of the higher oxide of cerium, a determination of the greatest scientific importance as regards the chemistry of the metals of the rare earths. Moreover they may be apt to forget that Bunsen was the first to introduce a general method of the separation of these rare earths, by which he for the first time prepared pure yttria and erbia, and by which subsequently, in the hands of other chemists, many new metals have been discovered His well-known method of flame-reactions is a standard example worked out by every student. Again, modern chemists can now scarcely carry on the simplest experiment without using the "Bunsen gas-lamp," a burner which is also now employed in every household, and in many manufactories,

and has become so necessary that it is difficult to conceive how we worked before its invention To him we are also indebted for the apparatus for accelerating filtration, the "Bunsen-pump," together with all its appliances, now employed in every laboratory

Of all the contributions to the advancement of our science, that by which the name of Bunsen has, however, become best known, and by virtue of which future generations will place him on the highest pinnacle of experimental fame, is the foundation, with his no less celebrated colleague Kirchhoff, of the science of Spectrum Analysis, and the discovery by its means of the two new alkali metals, cæsium and rubidium. It is true, of course, that many facts were ascertained and many observations made relating to the power possessed by matter in the state of incandescent gas emitting rays of a peculiar and characteristic kind Few great discoveries are made at one step But the glory of having established a new branch of science, of having placed "Analysis by Spectrum Observations" on a sound and firm experimental basis, belongs to the Heidelberg philosophers, and to them alone

The history of the establishment of spectrum analysis, as that of its enormous recent developments, is too well known to the readers of NATURE to require repetition All that is necessary here is to recall the masterly way in which Bunsen worked out the properties and showed the relationships of the new metals and their compounds He first saw the cæsium lines in a few milligrams of the alkaline residue obtained in an analysis of the Durkheim mineral waters, and the discovery of a second new metal (rubidium) soon followed that of the first So certain was he of the truth of his spectroscopic test that he at once set to work to evaporate forty tons (44,000 kilos) of the water, and with 16·5 grammes of the mixed chlorides of the two new metals which he thus obtained, he separated the one metal from the other (no easy task) and worked out completely their chemical relationship and analogies, so much so that the labours of subsequent experimenters have done little more than confirm and extend his observations, such a result is truly a marvel of manipulative skill!

Another less widely known, but no less interesting and important research, is that on the spark-spectra of the metals contained in cerite and other rare minerals. In this he shows his power both as physicist and chemist. He first describes a new chromic-acid battery suited to the performance of the special experiments which he afterwards details He determines with great care all the physical constants of this battery, and then proceeds to investigate the spectra of the earths which give no colour to the non-luminous flame. The spark-spectra of these earths he carefully maps, so completely, indeed, that the separation and identification of these metals now for the first time became possible.

The many hundreds of pupils who during the last half-century have been benefited by personal contact with Bunsen will all agree that as a teacher he is without an equal Those who enjoy his private friendship regard him with still warmer feelings of affectionate reverence. All feel that to have known Bunsen is to have known one of the truest and noblest-hearted of men.

H. E. ROSCOE

JAPAN

Japan, nach Reisen und Studien in Auftrage der k. Preuss Regierung dargestellt Von J J. Rein, Professor der Geographie in Marburg. Erster Band. Natur und Volk des Mikadoreiches. (Leipzig: Engelmann, 1881.)

Notes and Sketches from the Wild Coasts of Nipon. By Capt. H. C. St John, R.N (Edinburgh: Douglas, 1880.)

THE present year has already brought two new contributions to the rapidly increasing stock of Japanese literature in "Japan, nach Reisen und Studien," by Prof. Rein of Marburg, and "The Wild Coasts of Nipon," by Capt. St. John. The two works thus thrown into association by subject and time of publication have however nothing else in common.

Had Capt St. John's book been written a few generations ago, or had it related to a country previously unexplored, it would have possessed a greater claim upon popular interest; but Japan has in late years been so far the object of careful study by residents, and of descriptions by tourists, that the *raison d'être* of "The Wild Coasts of Nipon" is not easy to perceive.

In the preface the reader is assured that everything stated in the text, with a few exceptions, came under the observation of the author, and there is no doubt that he has scrupulously confined himself to his own personal experience, without seeking to correct or augment it by reference to other sources. The advantage of such a limitation of matter must however depend altogether upon the extent of the experience and the special qualifications of the observer, and we are of opinion that had the author taken the trouble to ascertain what his predecessors have already made known, he would have largely altered his notes

The author as a sportsman and naturalist displays himself in a more favourable light than as a logician and observer His sporting memoranda are amusing, and give a character to the volume, while as an amateur naturalist he shows more than average knowledge, and contributes some interesting facts on the subject of the animal kingdom. In the flora he is on less secure ground, and on one occasion, at page 137, confuses, in name at least, two such well known trees as the Hinoki (*Retinospora obtusa*) and the *Cryptomeria Japonica*.

In his remarks upon the people he bears good witness to the simplicity and kindness of the peasantry, of whom he must have seen a good deal. Unfortunately, for a traveller unlearned in the language, and chiefly dependent for his entertainment upon ordinary tea-houses, he has rather rashly ventured into generalisations requiring information that very few foreigners possess. At page 182 the Japanese men, as a race, are said to be "well made, muscular, active, and strong, and averaging about five feet five inches[1] in height," a description applying fairly well to the northern fishermen, but certainly flattering to the nation in general. Again, in several places the author follows a common fashion in deploring the evils brought upon the people by European "civilisation," but makes no allusion to the greater evils it is now

[1] Dr Rein's estimate of the average height of the men is 159 centimetres This is nearly as much below the mark as Capt St John's calculation is above it.

expelling, and ignores the fact that any deterioration which has followed the recent change of circumstances is not the work of "civilisation," but of the vile or foolish camp-followers that may cling to the skirts of even the noblest army.

Upon the religion of the country he says little more than is to be found in a footnote at page 127, but students may be interested to learn from this that "Shinto is never represented by any figure, but worshipped as the Unseen Spirit which pervades everything Buddha, as is well known, is always represented by a male figure; Shinto, the unrepresented, is supposed to be a female"

Criticism of the volume is to some extent disarmed by the modesty of its preface, and it no doubt contains much that will amuse the general reader.

In Dr. Rein's "Japan" we have the work not only of a *savant* thoroughly versed in his subject, but of a practised literary architect. The present volume deals with the geographical conformation, climate, flora, and fauna of the Japanese group, and the history, ethnography, and religion of the people, concluding with a useful chapter on topography. A future volume is to comprise an account of the industries and commerce, and will be welcomed by all who read the part now before us

The geographical summary is far more complete and accurate than any to which the public has yet had access, and at every page shows the hand of an expert who has brought original knowledge and personal observation to bear upon his task The climatic peculiarities are for the first time (save by the author himself in 1876) systematically described, and all the more important meteorological details accumulated in the past eighteen years in different parts of the country are reproduced in tabular form

In the study of the flora and fauna the accumulation of facts is already too large to allow the author to go far beyond the limits of enumeration. Since Dr Rein's account has been written a new addition has been made to the fauna in a catalogue of the birds of Japan by Capt. Blakiston and Mr. Pryer, and the number of known species raised from about 250 to 325, of which about 180 occur also in China, and about 100 are represented in Great Britain

It is to be regretted that space could not have been spared for a little supplementary information upon some of those members of the animal kingdom which possess a more popular interest. For example, a few details respecting the dangerous and unpleasantly common *Mamushi* (*Trigonocephalus Blomhoffii*) and the wrongly maligned little *Hibakari* (*Tropidonotus Martensii*) would have been useful. The poisonous properties of certain species of the *Fugu* or genus *Tetrodon* are pointed out, and the symptoms produced by their use as food described; but in the reference to the "*hungerige, blutgierige Mosquitos*," though feeling tribute is paid to the vexatious side of their character, the grave charges to which they are open are omitted, their probable agency, long recognised by native physicians, in the conveyance of malignant pustule, and the suspicion raised by Dr. Patrick Manson's investigations in Amoy, that the spread of Elephantiasis Arabum in the south of Japan is due to the same pest.

The second and less technical part of the book embraces subjects upon which the author is less able to speak *in verbâ magistri* than on geographical science. The section, "Das Japanische Volk," opens with an historical abstract of about 200 pages, compiled from Klaproth, Kæmpfer, Siebold, Satow, Aston, and other authorities. The purely mythical stories of the age of the gods are passed over rapidly, and the commencement of the history of the country is fixed at the reign of Jimmu Tenno (660 to 585 B C) Dr. Rein is generous enough to acknowledge without question the reputed founder of the imperial lore, of whose existence there is little more proof than of that of the *Uwabami* and *Kamaitachi*, which the Professor does not consider entitled to a place in the fauna As is mentioned in a footnote, the earliest written records extant originated in the first part of the eighth century of our era, and admitting the possibility that these were compiled from lost manuscripts of older date, they still offer satisfactory internal evidence that the historical being of Japan is at least a thousand years younger than is indicated by the list of the ancient emperors from whom the reigning Mikado traces his descent. The fact will perhaps be sufficiently demonstrated by a citation of the ages attributed to certain of the primitive rulers The inaugurative myth, Jimmu Tenno, is said to have lived 127 years, Koan, the sixth Mikado, 137 years, Nintoku, the seventeenth Mikado (D. 399 A D), 122 years, and it is not until the fifth century A D. that the viability of the rulers appears to have become permanently limited to a reasonable degree. It is true that the birth and death of Jimmu are solemnised as national festivals, and that writers on such sober topics as the industrial arts do not hesitate to refer for their landmarks to periods long antedating the true historical period, but all allowance must be made for inherited credulity in ancient traditions, which here form part of a state religion and establish the very sanctity of the throne

We are glad to see that Dr Rein does not altogether reject the romantic episodes of Japanese history Awaiting the advent of a native Walpole to bruise the simple faith of his countrymen with historic doubts, it is a grateful relief to the tedium of the long series of wars and court intrigues that form the burden of the rather monotonous recitative of the Oriental Clio, to dwell for a moment on such stories as those of the gentle wife of Yamato Dake, who cast herself into the sea to propitiate the angry gods that threatened the safety of her husband's ship, of Kesa, who sacrificed her life to preserve her wifely fidelity; and many others of the number that have lent inspiration to the pencils of Hokusai, Yosai, and a hundred lesser artists. They are probably no more apocryphal than many of the wearisome details through which the student of history must plod

The title 'Geschichte des Japanischen Volkes" adopted by the author is somewhat misplaced The history is not that of the people but of their rulers, and it would have been well had the author given the section a better claim to the heading by interspersing the story of battle and murder by some account of the development of laws, literature, painting, the various industrial arts, and such important social ceremonies as those of the *Cha-no-yu*, which lose much of their significance when divorced from the general history of the empire.

The most valuable portion of the sketch to the foreign world is that relating to the pregnant events of the last

twenty years. In the narration of occurrences which have compelled the foreign powers, and especially Great Britain, to join issue with the Japanese Government Dr. Rein displays an absence of partisanship quite novel to those experienced in the discussion of Anglo-Japanese politics. His review of the present position and future prospects of the nation is thoughtfully cautious, and while drawing attention to the recent educational studies and the many wise acts of the present Government, shows a dark reverse to the picture in the financial difficulties now threatening serious obstruction to the path of improvement The question of the opening of new ports or of the entire country to foreign enterprise and capital is also considered, and the writer points out the deadlock created on the one side by the great disadvantages which the Japanese foresee in admitting to competition an infinitely stronger commercial race, over whose actions they can have no judicial control, and on the other by the inexpediency, from the foreigners' point of view, of a surrender of the treaty rights while the laws and means of administration in Japan are in so unsatisfactory a condition as at the present time

In an interesting chapter upon the Ethnography of the Japanese the author takes up the vexed problem of the origin of the now dominant race, who displaced the aboriginal Ainos. He believes, from considerations of speech, physiognomy, and traditions that they are a branch of the old Altaic family, which spread from its birthplace in all directions over the continent of Asia, some reaching Japan *viâ* Tsushima, Iki, and Oki, others settling at various parts of the mainland to form the Korean, Mandschurian, and other kindred people In this view he is supported to some extent by the physiognomical identity with the Japanese of the yet pure descendants of the Korean potters brought over as trophies of Taiko's victorious arms at the end of the sixteenth century, and established in the province of Satsuma. Mr Aston's researches into the comparative philology of the Japanese and Korean languages (*Trans* Royal Asiatic Society, 1879) tend to a similar conclusion, but leave the question still open

The analyses of literature, language, and religion are necessarily incomplete, but awaiting the further progress of the labours of the scholars now engaged in the study of these special branches, Dr Rein's summary of the present knowledge will be of great service

The author's views as to the character of the Japanese as a race are neither romantically favourable, like those of the great majority of travellers, nor unjustly contemptuous, like the convictions cherished by nearly all settlers. The national defects Dr Rein considers to be a greed for novelty and a lack of stability and perseverance; but although this verdict would appear to be sanctioned by recent experience, the history of the country really points to nothing less than instability A blind admiration for antiquity and a persevering if not energetic industry has characterised nearly the whole of their older manufactures and artistic productions, and the many centuries of persistence in the path opened by their forefathers were terminated only by a sudden change of circumstances, and an entirely forced and unsought relationship with the outer world. They are now learning an entirely new exercise of their powers, and some clumsiness at the outset is inevitable, while the very impetuosity of their progression necessarily brings their faults more easily within the scope of a passing glance. They have now bought experience, and until the world sees how they can utilise their expensive purchase any judgment is premature They have indeed two serious drawbacks, poverty of material resources, and a written language that isolates them from the European world, and imposes serious limitations upon the interchange of the higher order of ideas amongst themselves, but the present generation can scarcely be blamed for either evil If there be a charge in the past and present to which they are fairly open it is defect of invention, for as their recent knowledge is taken from Europe, so in former times were they indebted to the Asiatic continent for literature, arts, religion, and laws, as well as for a thousand smaller traits of civilisation, some of which they have preserved longer or better than their teachers

Whatever dispraise is laid upon the people, nearly all writers agree to credit them with remarkable cleanliness. Miss Bird, however, who has studied Japan under a new aspect, gives a different testimony as to the interior, and the few travellers who have caught a glimpse of the unbeaten tracks of the great cities might make strange revelations. As the better class European generally knows little or nothing of the secrets of his own metropolitan slums, it is conceivable that a foreigner living in Tokio may not be aware that it contains other habitations than those he passes in the public thoroughfares; but were curiosity or chance to lead him to thread some of the little, hardly noticeable, inlets which here and there break the line of the street dwellings he would be startled by the new world revealed to him—one where the hundreds of thousands of poor of the great city live, densely packed in filth and disease, in dilapidated dens with crumbling walls and roofs that would render needless the spell of Asmodeus to the Don Cleofas who cares to peer at the miseries only half concealed by the long lines of sheds, moated with foul stagnant drains, flanked by reeking accumulations of sewage and garbage, and cut off from ventilating breezes by the dwellings of the more fortunate but less numerous citizens. Had Dr. Rein extended his pilgrimage to the *Uradana* he would have written a new and curious chapter.

As regards bathing, it is certainly a common custom, but with the poorer classes it is far less frequent than travellers would lead us to believe. It is moreover not so much dictated by any unconquerable intolerance of dirt as by the combined attractions of warm water and neighbourly gossip Whatever purification may be derived from the common use of a limited quantity of water by several dozens of people, it is doubtful whether we may not take as a set-off the odoriferous condition of the unwashed winter garments which often do unrelieved duty day and night for the whole season, and the very scant attention that the native feels impelled to bestow upon his hands and face in the intervals of his visits to the bathing-house. These remarks however do not imply that the working orders in Japan compare unfavourably in respect to physical purity with their European brethren.

The maps and illustrations are excellent in choice and execution. One error must however be indicated in the woodcut described as a "*Riu-kiu-Insulander*," which is

really an accurate portrait of the Korean envoy who visited Japan in 1877

It is impossible to do justice to Dr. Rein's important book in the space at our command Its construction is eminently scientific, and its thoroughness will excite the admiration of all who know the difficulty of obtaining, and especially of selecting, information upon many of the matters so exhaustively treated The errors are few and seldom important, and will probably disappear in the next edition. One powerful recommendation is the absence of the *ego* from its pages, the author everywhere studiously keeps his own individuality concealed, and in the discussion of most points he is nearly always contented with such a statement and grouping of the principal facts as will leave the inference well within the grasp of the reader's mind In conclusion, it is the best of the many publications upon the subject of Japan that have appeared in the last ten years, and, unlike most of the number, supplies a real want, and will be received gratefully by all who seek for solid, trustworthy information. We trust that the completion of the work will soon be issued.

OUR BOOK SHELF

Études géométriques et cinématiques. Note sur quelques Questions de Géométrie et de Cinématique, et Réponse aux Réclamations de M l'Abbé Aoust. Par E J. Habich. 80 pp. (Lima, 1880)

M. L'ABBÉ AOUST, author of the "Analyse infinitésimale des Courbes planes," and our author put forward conflicting claims as to priority of discovery.

The polemics have fired off their powder in *Les Mondes* (tome iv, 1880, Aoust tome i, 1879, Habich, see also the *Comptes rendus*, lxxxv, 1877, and lxxxix, 1879), and the object of the present pamphlet is "de réduire à leur juste valeur les assertions" of the Abbé The matters in dispute can be inferred from the three divisions of the present work —

"1. Développoides—considérations historiques, étude des enveloppes des droites par la considération du centre instantané de rotation, développoides des divers ordres et devellopoides inverses

"2. Coordonnées tangentielles-polaires.

"3. Mouvement géométrique d'une figure plane dans son plan—considérations générales, mouvement géométrique déterminé par deux systèmes d'enveloppées et d'enveloppes, mouvement d'une droit sur un plan"

We have, of course, but one side of the quarrel presented to us, but leaving polemics on one side there is a great deal of interesting matter put before us. Time will, no doubt, settle the question of priority.

A Synopsis of Elementary Results in Pure and Applied Mathematics. By G. S. Carr, B.A. Vol. i. part viii. (C F. Hodgson and Son, 1880)

WE recently noticed with approval the volume containing the first seven parts This eighth part carries on the articles from 1400 to 1868, and is concerned with the differential calculus It contains an abstract of the usual processes, and besides gives a succinct account of the theory of operations, and an analysis of matters which are treated of in the higher algebra, as Jacobians and quantics, and closes with maxima and minima, the geometrical applications being reserved for the parts on Co-ordinate Geometry.

These fifty-six pages are very correctly printed, at least we have not detected more than three or four trivial typographical errors

This part maintains the handy character for reference of its forerunners.

The Practical Fisherman. By T. H Keene (London. *The Bazaar* Office)

THIS book deals with the natural history, the legendary lore, and the capture of British freshwater fish, together with the art of tackle-making The author has bestowed great care on his work, and seems to have studied every book written or published on the charming subject from Oppian to the present time Mr Keene is besides an enthusiastic fisherman, and has thus produced a treatise of great interest to the practical angler. We may add that this work is almost the only one on angling which treats of the natural as well as the traditional history of fishes

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications*

[*The Editor urgently requests correspondents to keep their letters as short as possible The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

The Movements of Leaves

FRITZ MUELLER has sent me some additional observations on the movements of leaves, when exposed to a bright light. Such movements seem to be as well developed and as diversified under the bright sun of Brazil, as are the well-known sleep or nyctitropic movements of plants in all parts of the world This result has interested me much, as I long doubted whether paraheliotropic movements were common enough to deserve to be separately designated It is a remarkable fact that in certain species these movements closely resemble the sleep movements of allied forms. Thus the leaflets of one of the Brazilian Cassiæ assume when exposed to sunshine nearly the same position as those of the not distantly allied Hæmatoxylon when asleep, as shown in Fig. 153 of "The Movements of Plants" Whereas the leaflets of this Cassia sleep by moving down and rotating on their axes, in the same peculiar manner as in so many other species of the genus Again, with an unnamed species of Phyllanthus, the leaves move forwards at night, so that their midribs then stand nearly parallel to the horizontal branches from which they spring, but when they are exposed to bright sunshine they rise up vertically, and their upper surfaces come into contact, as they are opposite Now this is the position which the leaves of another species, namely *Phyllanthus compressus*, assume when they go to sleep at night. Fritz Muller states that the paraheliotropic movements of the leaves of a Mucuna, a large twining Papilionaceous plant, are strange and inexplicable, the leaflets sleep by hanging vertically down, but under bright sunshine the petio[illegible] rises vertically up, and the terminal leaflet rotates by mea[illegible]s pulvinus through an angle of 180°, and thus its upper surfa[illegible]nds on the same side with the lower surfaces of the lateral leafle[illegible] Fritz Muller adds, "I do not understand the meaning of this rotation of the terminal leaflet, as even without such a movement it would be apparently equally well protected against the rays of the sun. The leaflets, also, on many of the leaves on the same plant assume various other strange positions." With one species of Desmodium, presently to be mentioned as sleeping in a remarkable manner, the leaflets rise up vertically when exposed to bright sunshine, and the upper surfaces of the lateral leaflets are thus brought into contact. The leaves of *Bauhinia grandiflora* go to sleep at an unusually early hour in the evening, and in the manner described at p 373 of "The Movements of Plants," namely, by the two halves of the same leaf rising up and coming into close contact now the leaves of *Bauhinia Brasiliensis* do not sleep, as far as Fritz Muller has seen, but they are very sensitive to a bright light, and when thus exposed the two halves rise up and stand at 45° or upwards above the horizon

Fritz Muller has sent me some cases, in addition to those given in my former letter of March 3, of the leaves of closely-allied plants which assume a vertical position at night by widely different movements; and these cases are of interest as indicating that sleep movements have been acquired for a special purpose. We have just seen that of two species of Bauhinia the leaves of one sleep conspicuously, while those of a second species appa-

rently do not sleep at all The leaves of *Euphorbia jacquiniæflora* depend vertically at night, whereas those of a dwarfish Brazilian species rise vertically up at night. The leaves of this Euphorbia stand opposite one another—a position which is rather rare in the genus; and the rising movement may be of service to the plant, as the upper surfaces of the opposite leaves mutually protect one another by coming into contact. In the genus Sida the leaves of two species rise, while those of a third Brazilian species sink vertically down at night Two species of Desmodium are common plants near Fritz Muller's house in one the leaflets move simply downwards at night; but in the other not only do the three leaflets move vertically down, while the main petiole rises vertically up, as is likewise the case with *D. gyrans*, but in addition the lateral leaflets rotate so as to stand parallel with the terminal leaflet, behind which they are more or less completely hidden. This, as far as I have seen, is a new kind of nyctitropic movement, but it leads to a result common to several species, namely, that of packing the three leaflets closely together and placing them in a vertical position

Down, Beckenham, Kent, April 14 CHARLES DARWIN

Spectrum of the Star Ll. 13412

THE spectrum of the star Ll 13412 appears to be in some respects unique It consists mainly of three bright lines having wave lengths of 545, 486, and 466 millionths of a millimetre. Four other stars have hitherto been found whose spectra are of this character Three of them are in Cygnus, and have lines whose wave-lengths are 580, 568, 536, and 467 The fourth star, Oeltzen 17681, has lines at about 582 and 470 (NATURE, vol xxii. p 483) The line or band at 467 appears to be common to all, and that at 580 to the last four The line at 486 in Ll 13412 coincides with the F line of hydrogen, but is not visible in the other stars The line at 545 is also absent in them This star therefore appears to resemble the others in kind, but not in the material of which it is composed. It is also much brighter than the others, so that it is not a difficult object with a small telescope Its position for 1880 is in R.A 6h. 49·3m and Dec. $-23°$ 47′. It is easily found as a seventh magnitude star about 15′ north of o′ *Canis Majoris*.

Cambridge, U.S , April 14 EDWARD C. PICKERING

The Indian Winter Rains

IN NATURE, vol. xxiii p 400, Mr. F Chambers very properly points out that the winter rains of Northern India, though usually heaviest in years when the *mean* pressure is above the average, are yet coincident with short periods of low rather than of high pressure The way in which Mr Chambers accounts for the low pressure seems, however, rather far-fetched It is true that on one or two of the American weather charts storm tracks are shown extending from the Mediterranean to Northern India or the Bay of Bengal, but these paths are drawn with dotted lines indicating that they are doubtful, and, considering the absence of meteorological stations in the greater part of the area between the Mediterranean and India, and the nature of the intervening country—especially Afghanistan with its high mountains—I should say the evidence upon the strength of which the American chartographer laid down these storm tracks, was of the slightest possible description The winter rains are however accompanied by a cyclonic movement of the air over Northern India, and I wish to point out that, whether the cyclonic disturbance be a European or Transatlantic visitor, as Mr. Chambers supposes, or a native of the Indian region, generated by the rainfall, as Mr. Eliot has taught in his report for 1877, the "old notion" of the connection of the rains with the upper antimonsoon current is by no means exploded The progress of the disturbance and of the rainfall is usually from north west to south-east, and the rainfall is heaviest, as a rule, on the eastern side of the disturbance The winds which bring the rainfall therefore come from some southerly quarter, and as northerly winds generally continue blowing in the extreme south of India at the time when these disturbances occur in the north, the southerly rainy winds must be derived from an upper current which descends in the anti-cyclone or region of high pressure in the centre and south of India, or in the zone between the south of India and the equator. Mr Blanford's modification of his former views regarding the origin of these rains appears from his remarks and the accompanying charts in the Meteorological Report for 1878 to be merely that the indraught towards the region of precipitation is not confined to Northern India, but is occasionally, though rarely, felt as far south as Ceylon.

In a letter of mine that appeared in NATURE for the following week (p. 409), there was a mistaken inference from Mr. Blanford's investigation regarding the "Barometric See-saw" between India and West Siberia that I beg your permission to correct. The mean pressure at sea-level in the Indo Malayan and West Siberian regions appears from Mr. Buchan's charts to be nearly the same both on the average of the year and in January and July. Also no wind blows directly from the one region to the other We cannot therefore infer anything regarding the strength of the winds from Mr. Blanford's results, but we may regarding temperature. The proper inferences of this kind from the results arrived at by Mr. Blanford and Mr Archibald appear to be these —(1) The range of temperature in the 11-year period is greater in Siberia than in surrounding countries, (2) Siberia is coldest, compared with neighbouring countries, at times of maximum sun-spot, (3) This relation is most marked in winter, and (4) near the coasts of the Pacific (Nertchinsk, Pekin, Zi ka-wei), the Indian (all the Indo-Malayan stations, especially those nearest the sea), and the Atlantic (London) oceans, where presumably the range of temperature is less than in the heart of the continent, the variation of the barometer in the 11-year period is opposite to that observed in Siberia S A. HILL

Allahabad, March 29

Palæolithic Man

IT is desirable that further search should be made for implements made by man in the deposits of this country assumed to be older than the well-known and accepted implementiferous river-gravels

In the gravels belonging to the Thames, in and near London, palæolithic implements are of not infrequent occurrence. In my own collection I have more than 120 examples—with few exceptions found by myself—and I know of at least another hundred specimens found chiefly by London friends who have availed themselves of hints given by me.

My object now is to direct attention to the fact that the implements are not only found in and near London in the lower and middle terraces of gravel some 25 to 70 feet above the ordnance datum, but at far greater heights. Some of these heights near London may, and others no doubt do, belong to the Thames or to its tributaries, but they all (in different degrees) appear to point to a more remote time than the period when the lower terraces of the Thames and its tributaries were formed Some of the implements now found in the lower gravels are clearly "derived" from more ancient deposits For instance, I have one example white in colour and highly porcellaneous —the white colour has been brought about by the decomposition of the flint in some ancient loam or clay, and not from the gravel in which the implement was found this is proved by several more or less highly-polished accidental fractures at the edges of a different colour from the general white surface. these coloured fractures are more recent than the white facets, and date from the last deposition of the implement in the lower terrace· the white abraded flakings belong to a highly remote time Dr. John Evans records the finding of an implement in the Thames gravel at Highbury, at 102 feet, whilst I have found one (also near Highbury), at an elevation of 144 feet. Last summer I found an implement on the eminence at the north of, and overlooking Ealing Dean, at a height of 164 feet. This is 72 feet higher than the implementiferous beds of Ealing Dean described by General Pitt Rivers, and between 80 and 100 feet higher (in one instance 104 feet higher) than the implement-bearing gravels at Acton described by the same gentleman. The gravel at the 164-feet elevation forms an isolated patch on the extreme top of a hill. I watched the excavations here (which were shallow) for road-making, with great care, and with the implement I found several flakes. These heights agree well with the heights of some of the implementiferous gravels found capping the cliffs in the South of England, also with the Erith position at Northumberland Heath, where Mr F. C. J. Spurrell found an implement at an elevation of 175 feet.

Most geologists know the high gravels overlooking Hertford, Ware, and Amwell, their altitude is from 130 to over 180 feet above the ordnance datum. Gravel from the two first of these places is brought to London for ballast in thousands of tons. A year or two ago great quantities of gravel from Hertford were brought to Finsbury Park by the Great Northern Railway, and in the gravel thrown down near Finsbury Park I

picked up a good sub-triangular wedge-shaped implement. Further search produced a second implement, a good trimmed flake, and a few simple flakes. The worked flints in the Hertford gravel are however so rare that the search for them is the most hopeless task conceivable. There is not more than one flake in 500 tons, not one implement in 5000 tons of gravel. The gravel from Ware is also brought to the east of London for ballast, and I happened last year to mention the fact of my discoveries to Mr. J. E. Greenhill, the Principal of a school near Hackney Downs. Mr. Greenhill at once not only searched himself, but set his pupils to look over the Ware gravel, then laid down in large quantities near Clapton, with the result that a large broken ovate implement was found and several flakes. I also found a large and heavy "slice" flake with numerous facets on its worked side in the same gravel. Mr. Greenhill's success caused me to look carefully over a similar lot of gravel from Ware, laid down near Victoria Park. In this I found a sub-triangular implement and three flakes. I have also found a large greatly abraded flake in the Amwell gravel at Amwell. Elsewhere in east and north-east London I have looked over thousands of tons of Hertford and Ware gravel without decisive result. A week or two ago, however, as my younger son was returning home through Finsbury Park, he picked up a good scraper-like implement in the gravel (presumably from Hertford), just thrown on to the road inside the park. On hearing of the discovery I at once went to Finsbury Park and looked carefully over all the recently thrown down material, but with no further result. I have visited the different pits at Hertford, Ware, and Amwell several times, but there is never enough gravel exposed (considering the extreme comparative rarity of the implements and flakes) to give one a chance of finding an implement. I have found in the pits several simple flakes, with the cone of percussion, and that is all. At what depth the implements occur in the gravel I do not know, but that implements really do come out of the high gravels overlooking Hertford and Ware I think there can be no doubt. Reference was made by me to these implements at the Anthropological Institute three years ago, when two or three specimens were exhibited by me.

WORTHINGTON G. SMITH

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Sound of the Aurora

WITH every respect for the ability and acuteness of the late Sir John Franklin and his companions, I do not think it conclusive, as Mr. Rouse seems to do, that because they heard no sounds "with the aurora borealis" (NATURE, vol. xxiii. p. 556), no sounds are produced by it.

All Indians, both on the shores of Hudson's Bay and near Bear Lake, and the Eskimos on many parts of the coast, assert positively that the bright, varying, flickering,[1] and rapidly-moving auroræ do produce sound. The senses of hearing and smelling in the Indian and Eskimo are far more acute than in the civilised man; and both sounds and smells which to the latter are not perceptible are perfectly so to the more sensitive auditory and olfactory organs of the savage.

The theory that "the attractive force of the aurora is increased within a certain limit as its rays proceed southward" is scarcely borne out by my experience.

When wintering at Fort Hope, Repulse Bay, in 1846-47 and 1853-54, lat. 66° 32′ N., the result of my observations was, as far as I can discover, exactly similar to that of Parry in 1824-25 at Port Bowen in lat. 73° 15′ N., 400 miles further north and fifty miles west of Fort Hope; at both no effect was produced on the magnetic needle.

At Repulse Bay, and it may have been the same at Port Bowen, the character of the aurora was perfectly different from that generally seen at Great Bear Lake, which acted so powerfully on the needle, the former being almost always of a uniform pale yellow or straw colour, with little rapid motion, whereas the latter was generally flashing, flickering, rapidly moving, and of diverse hues.

One peculiarity of the auroræ observed at Repulse Bay may be worthy of notice: they were chiefly seen to the magnetic south—that is south 62° east true—usually in the form of an arch rather low down—and I may add that in that direction at a distance of thirty or forty miles from our head-quarters a large extent of sea is kept open all winter by strong currents. The Eskimos of Repulse Bay do not say much about the aurora beyond expressing a belief that it is the spirits of their dead visiting each other in the heavens.

[1] I borrow this most appropriate term from Prof. Stokes, F.R.S., &c., of Cambridge.

It is probably a matter of little or no importance in a question of this kind, but Mr. Rouse has given the latitudes of the southern shores of Great Bear Lake from 90 to 200 miles too far north.

Fort Franklin, where Franklin made his chief observations, is situated in latitude 65° 12′ N. at the extreme south-west of Great Bear Lake, whereas Fort Confidence, where Sir J. Richardson and I made ours with like results, is at the extreme north-east of the lake in lat. 66° 54′ N., the stations being 150 miles distant from each other.

It is perhaps not being too sanguine to hope that in this period of marvellous discoveries, some instrument may be—if not already—invented, with the aid of which one may be able to decide the question satisfactorily as to whether the aurora in any form does or does not produce sound.

JOHN RAE

4, Addison Gardens, April 16

THE SCIENTIFIC PRINCIPLES INVOLVED IN ELECTRIC LIGHTING[1]

II.

Lectures III. and IV.

ALL machines for the conversion of mechanical work into electricity are founded on Faraday's great discovery of the induced current derived from the relative motion of a magnet and a coil of wire. They are either continuous-current or alternate-current machines. From the continuous-current machines of Pixii in 1832 and Saxton and Clarke in 1835 and 1836, we pass to Wheatstone's introduction in 1845 of electromagnets in place of permanent magnets to produce the magnetic field. In 1854 Werner Siemens and Halske introduced the Siemens armature, in which the coil is wound longitudinally in a groove. In 1854 Hjorth patented an improved magneto-electric battery, in which the currents induced in the revolving armature pass round the electromagnets and produce the magnetic field. This is the principle of the dynamo-electric machine, which was afterwards rediscovered by Siemens and by Wheatstone simultaneously in 1867, when on the same evening their two papers were presented to the Royal Society.

Then followed the Gramme armature, in which coils of wire are wound in sections all in the same direction round a ring, each section, when a current is flowing through it, may be regarded as an electro-magnet, and its principle of action is clear at once from the principles of Arago and from Lenz's laws for induced currents.

In dynamo-electric machines the external work in the electric arc is proportional to the square of the current, and is also proportional to the number of turns of the armature per minute.

Any disturbance in the resistance of the arc reacts on the electro-magnet, altering the strength of the magnetic field, thereby increasing the disturbance; this is the great disadvantage of dynamo-electric machines as compared with magneto-electric machines, where the magnet is either a permanent magnet or is excited by means of a separate current. Wilde, in 1863, employed a separate continuous current machine to give a permanent magnetic field, and made the armature of the second machine to revolve in this magnetic field. In alternate-current machines there is no commutator for making the current continuous, but the currents from the coil are collected and sent through the external resistance in opposite directions for every half-turn of the armature. The Alliance magneto-electric machine was the first of these, which was converted by Holmes into a continuous-current machine, and was by him first used in 1858 to produce the electric light for lighthouse illumination. He afterwards again converted his machine into an alternate-

[1] By Prof. W. Grylls Adams, F.R.S. Continued from p. 582.

current machine by removing the commutator, thereby producing a very effective machine.

All theoretical determinations of the efficiency of machines are complicated by the retardation of magnetisation of the magnets, which necessitates a change of position of the commutator or brushes in the direction of the rotation of the armature. The practical determinations of efficiency which have been made show that from 86 to 88 per cent of the energy communicated to a dynamo-machine is converted into electrical energy, and that from 44 to about 50 per cent. of the total work may be converted into useful work in the external circuit. Among the more recent continuous current machines are the Brush and the Burgin machines, which promise to give good results.

At intervals during the lecture the room was lighted by various electric lamps, the peculiarities of each of which were explained The Brockie lamp, lent by the British Electric Light Company, and served by one of their Gramme machines, the Siemens pendulum-lamp lent by Dr. Siemens, and the Crompton lamp lent by Mr. Crompton, were each tried in turn, and attention was drawn to the Siemens' differential lamp, the Brush lamp, and other lamps and electric candles which were also exhibited.

The subject of the fourth Cantor lecture was the subdivision of the electric current and lighting by incandescence. Prof Adams showed that objections raised to the electric light were similar to those which had been urged with regard to gas when it was first introduced. He then compared the energy of Grove's cells with the energy derived from a small Gramme machine, and showed how impracticable it was to attempt to do by means of batteries the work which can be done by such machines He then explained how the same amount of energy might be spent in two classes of machines, those of low internal resistance and low electromotive force which send a strong current through small external resistance, or quantity machines, and those of high internal resistance and high electromotive force sending a smaller current through large external resistance, or tension-machines For very high resistances the discharge of an induction-coil is taken, the action of which was compared to the action of the hydraulic ram. Prof Adams proceeded to describe the Werdermann and the Joel lamps, and explained the kind of machine specially suited for such lamps, and regretted that it would not be possible to show them to the best advantage, or to give them a fair trial, because the machine actually in use at the speed at which it was running was not adapted for them. An electromotive force of 130 volts will send 50 webers through 10 lamps in series, and give an illumination of 320 candles in each lamp for an expenditure about 10 h.p. Taking Mr A. Siemens' facts as to the cost, it appears that the electric light from the Joel lamp would be as cheap as gas at the rate of 2*s*. per 1000 cubic feet. The laws of the subdivision of the electric current were discussed, and their application to the system of incandescent lighting adopted by Swan, and by Lane-Fox and Edison was clearly shown With the Burgin machine, then in use, giving at 1620 revolutions a minute an electromotive force of 160 volts, and a current of 24 webers through an external resistance of about 7 ohms, it was shown that 24 rows of two Swan lamps in series or 48 lamps could be lit up each lamp being of 80 ohms resistance, and giving a 48 candle-power light. If the resistance of each lamp be 40 instead of 80 ohms, then double the number of lamps might be taken in series, giving about 100 lamps from the machine.

With the Brush machine at least 140 lamps might be lit up in 10 parallel rows of 14 lamps in series. The early attempts of King, and Staite, and Konn to light by incandescence were then explained, and experiments made to illustrate the phenomena seen in high vacua, such as are necessary to enable Mr. Swan and Mr Lane Fox to preserve their carbons from wasting when rendered incandescent by means of the electric current.

The room was well lighted by means of 20 Swan lamps, each giving a pleasant and steady light of about 40 or 50 candle-power, the lamps being arranged in 10 rows of two in series. Two table-lamps were placed on the lecture-table, which could be put out separately or made to glow at pleasure, and these lamps could be lifted off their stands and others put in their places without disturbing other lights which were arranged in multiple arc and worked from the same dynamo-machine.

THE FRENCH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AT ALGIERS[1]

II.

Algiers, April 17

On Friday afternoon various papers on local subjects were read to a general audience in the *foyer* of the theatre They related to the geology, geography, and demography of Algeria, but the most interesting paper was by our Consul-General, Col Playfair, on a visit to the country of the Kroumirs—interesting not only because the aggressions of this tribe have led to the present complications in Tunis, which will probably end in war, but also because Col. Playfair and Lord Kingston are the only Europeans who have visited their country. They inhabit the district near Le Calle, that is to say, the northern portion of the boundary between Algeria and Tunis, and they only nominally acknowledge the suzerainty of the Bey of Tunis

On Friday evening a discourse was delivered in the theatre "On Paludisme from a Surgical Point of View" It was of such a very technical character that many members of the Association did not attend In fact the Congress is to a great extent medical While the Physical and Botanical Sections are positively languishing for want of papers, and will probably come to a premature ending on Monday, the papers waiting to be read before the Medical Section fill two pages of yesterday's programme.

More activity was manifested in the sectional work on the second day of the Congress; the papers in most of the sections were more numerous and the audiences larger. The physical section is the most neglected of all Long after the proper time of commencement the president had not made his appearance, and at length Mr Siemens, the only honorary vice-president, was requested to take the chair. Of the four papers read three were by Englishmen, and on the first day of meeting one paper alone was read by a Dutchman Pure physics in France is unfortunately quite unrepresented at the Congress. In the Chemical Section M. Baunhauer read a paper "On the Crystallisation of the Diamond," and M. de Foreland "On a New Apparatus for Gas Analysis." There were several good papers on meteorological subjects. Only three papers were read in the Geological Section, the most important of these by M. Villanova, "On the Unification of Geological Nomenclature." The Anthropological Section was well attended, and papers of considerable local interest were read. The Sections of Geography and Political Economy mainly discussed the Sahara—on the one hand its physical geography, and on the other its colonisation.

In the Agricultural Exhibition one of the most interesting machines is the solar engine, the boiler of which is placed in the axis of a mirror 14 feet in diameter, and formed of three portions of hollow truncated cones, so as to get a close approximation to the parabola. When the sun shines a pressure of from three to four atmospheres is produced in the boiler, and a force of one-horse power is produced through the intervention of an

[1] Continued from p 583.

ordinary steam-engine. The mirror is of silvered copper, the boiler is blackened and is surrounded by a glass cylinder, which of course permits the passage of the sun's heat through it, but obstructs its escape after absorption. The whole thing costs 4000 francs, and it could be used in many countries for at least 200 days in the year

G. F. RODWELL

THE HERRING[1]

IT is now nineteen years since my attention was first specially directed to the natural history of the herring, and to the many important economical and legal questions connected with the herring fisheries As a member of two successive Royal Commissions, it fell to my lot to take part in inquiries held at every important fishing station in the United Kingdom between the years 1862 and 1865, and to hear all that practical fishermen had to tell about the matter; while I had free access to the official records of the Fishery Boards Nor did I neglect such opportunities as presented themselves of studying the fish itself, and of determining the scientific value of the terms by which, in the language of fishermen, the various conditions of the herring are distinguished.

Diligent sifting of the body of evidence thus collected and passed under review, led to the satisfactory clearing away in my own mind of some of the obscurities which, at that time, surrounded the natural history of the fish But many problems remained, the solution of which was not practicable by investigations which, after all, were only incidents in the course of a large inquiry, embracing a vast number of topics beside herrings and herring fisheries, and it is only within the last few years that the labours of the German West Baltic Fishery Commission have made such large additions to the state of our knowledge in 1865, that the history of the herring is brought within measurable distance of completeness

Considering the vast importance of the herring fisheries of the Eastern Counties, it occurred to me when the President of the National Fishery Exhibition did me the honour to ask me to address you, that nothing could be more likely to interest my audience than a summary statement of what is now really known about a fish which, from a fisherman's point of view, is probably the chief of fishes

I am aware that I may lay myself open to the application of the proverb about carrying coals to Newcastle, if I commence my observations with a description of the most important distinctive characters of a fish which is so familiar to the majority of my hearers And perhaps it is as well that I should at once express my belief that most of you are as little likely to mistake a herring for anything else as I am Nay, I will go further I have reason to believe that any herring-merchant, in a large way of business, who may be here, knows these fish so much better than I do, that he is able to discriminate a Yarmouth herring from a Scotch herring and both from a Norway herring, a feat which I could not undertake to perform. But then it is possible that I may know some things that he does not He is very unlike other fishermen and fish-merchants with whom I have met, if he has any but the vaguest notions of the way of life of the fish, or if he has heard anything about those singularities of its organisation which perplex biologists; or if he can say exactly how and why he knows that a herring is not a sprat, a shad, or a pilchard. And all kinds of real knowledge and insight into the facts of nature do so bear upon one another and turn out in strange ways practically helpful, that I propose to pour out my scientific budget, in the hope that something more may come of it than the gratification of intelligent curiosity

If any one wants to exemplify the meaning of the word "fish" he cannot choose a better animal than a herring The body, tapering to each end, is covered with thin, flexible scales, which are very easily rubbed off. The taper head, with its underhung jaw, is smooth and scaleless on the top, the large eye is partly covered by two folds of transparent skin, like eyelids—only immovable and with the slit between them vertical instead of horizontal, the cleft behind the gill cover is very wide, and, when the cover is raised, the large red gills which lie beneath it are freely exposed The rounded back bears the single moderately long dorsal fin about its middle The tail fin is deeply cleft, and on careful inspection small scales are seen to be continued from the body, on to both its upper and its lower lobes, but there is no longitudinal scaly fold on either of these The belly comes to an edge, covered by a series of sharply-keeled bony shields between the throat and the vent, and behind the last is the anal fin, which is of the same length as the dorsal fin There is a pair of fore-limbs, or pectoral fins, just behind the head, and a pair of hind-limbs, or ventral fins, are situated beneath the dorsal fin, a little behind a vertical line drawn from its front edge, and a long way in front of the vent These fins have bony supports or rays, all of which are soft and jointed.

Like most fishes, the herring is propelled chiefly by the sculling action of the tail-fin, the rest serving chiefly to preserve the balance of the body, and to keep it from turning over, as it would do if left to itself, the back being the heaviest part of the fish

The mouth of the herring is not very large, the gape extending back only to beneath the middle of the eye, and the teeth on the upper and lower jaws are so small as to be hardly visible Moreover, when a live herring opens its mouth, or when the lower jaw of a dead herring is depressed artificially, the upper jaw, instead of remaining fixed and stationary, travels downwards and forwards in such a manner as to guard the sides of the gape This movement is the result of a curious mechanical arrangement by which the lower jaw pulls upon the upper, and I suspect that it is useful in guarding the sides of the gape when the fish gulps the small living prey upon which it feeds.

The only conspicuous teeth, and they are very small, are disposed in an elongated patch upon the tongue, and in another such patch, opposite to these, on the fore part of the roof of the mouth. The latter are attached to a bone called the vomer, and are hence termed vomerine teeth But, if the mouth of a herring is opened widely, there will be seen, on each side, a great number of fine, long, bristle-like processes, the pointed ends of which project forwards These are what are termed the gill rakers, inasmuch as they are fixed, like the teeth of a rake, to the inner sides of those arches of bone on the outer sides of which the gills are fixed. The sides of the throat of a herring, in fact, are as it were cut by four deep and wide clefts which are separated by these gill arches, and the water which the fish constantly gulps in by the mouth flows through these clefts, over the gills and out beneath the gill covers, aerating the blood, and thus effecting respiration, as it goes But since it would be highly inconvenient, and indeed injurious, were the food to slip out in the same way, these gill rakers play the part of a fine sieve, which lets the water strain off, while it keeps the food in The gill rakers of the front arches are much longer than those of the hinder arches, and as each is stiffened by a thread of bone developed in its interior, while, at the same time, its sides are beset with fine sharp teeth, like thorns on a brier, I suspect that they play some part in crushing the life out of the small animals on which the herrings prey.

Between these arches there is, in the middle line, an opening which leads into the gullet. This passes back into a curious conical sac which is commonly termed the stomach, but which has more the character of a crop.

[1] A lecture delivered by Prof. Huxley at the National Fishery Exhibition, Norwich, April 21, 1881

Coming off from the under side of the sac and communicating with it by a narrow opening, there is an elongated tubular organ, the walls of which are so thick and muscular that it might almost be compared to a gizzard. It is directed forwards, and opens by a narrow prominent aperture into the intestine, which runs straight back to the vent Attached to the commencement of the intestine, there is a score or more of larger and shorter tubular organs which are called the pyloric cæca. These open into the intestine, and their apertures may be seen on one side of it, occupying an oval space, in the middle of which they are arranged three in a row

The chief food of the herring consists of minute Crustacea, some of them allied to the shrimps and prawns, but the majority belonging to the same division as the common *Cyclops* of our fresh waters These tenant many parts of the ocean in such prodigious masses that the water is discoloured by them for miles together, and every sweep of a fine net brings up its tens of thousands.

Everybody must have noticed the silvery air-bladder of the herring, which lies immediately under the backbone, and stretches from close to the head to very near the vent, being wide in the middle and tapering off to each end In its natural state, it is distended with air; and, if it is pricked, the elastic wall shrinks and drives the air out, as if it were an indiarubber ball When the connexions of this air-bladder are fully explored it turns out to be one of the most curious parts of the organisation of the whole animal

In the first place, the pointed end of the sac or crop into which the gullet is continued runs back into a very slender duct which turns upwards and eventually opens into the middle of the air-bladder. The canal of this duct is so very small and irregularly twisted, that, even if the air-bladder is squeezed, the air does not escape into the sac. But, if air is forced into the sac by means of a blowpipe, the air passes without much difficulty the other way, and the air-bladder becomes fully distended. When the pressure is removed, however, the air-bladder diminishes in size to a certain extent, showing that the air escapes somewhere And if the blowing up of the air-bladder is performed while the fish is under water, a fine stream of air-bubbles may be seen to escape close to the vent Careful anatomical investigation, in fact, shows that the air-bladder does not really end at the point where its silvery coat finishes, but that a delicate tube is continued thence to the left side of the vent, and there ends by an opening of its own

Now the air-bladder of all fishes is, to begin with, an outgrowth from the front part of the alimentary canal, and there are a great many fishes in which, as in the herring, it remains throughout life in permanent communication with the gullet. But it is rare to find the duct so far back as in the herring; and, at present, I am not aware that the air-bladder opens externally in any fishes except the herring and a few of its allies

There is a general agreement among fishermen that herrings sometimes make a squeaking noise when they are freshly taken out of the water I have never heard this sound myself, but there is so much concurrent testimony to the fact that I do not doubt it, and it occurs to me that it may be produced when the herrings are quickly brought up from some depth by means of this arrangement For under these circumstances the air, which the air-bladder contains, expands to such a degree, on being relieved from the pressure of the water, that deep-sea fishes with a closed air-bladder which are brought to the surface rapidly are sometimes fairly turned inside out by the immense distension, or even bursting, of the air-bladder. If the same thing should happen to the herring the like misfortune would not befall it, for the air would be forced out of the opening in question, and might readily enough produce the squeak which is reported The common Loach [1] is said to produce a piping sound by expelling the air which this fish takes into its intestine for respiratory purposes

At the opposite end of the air-bladder there is an even more curious arrangement. The silvery coat of the air-bladder ends in front just behind the head. But the air-bladder itself does not terminate here. Two very fine canals, each of which is not more than a two-hundredth of an inch in diameter, though it is surrounded by a relatively thick wall of cartilage, pass forward, one on each side, from the air-bladder to the back of the skull. The canals enter the walls of the skull, and then each divides into two branches. Finally, each of these two dilates into a bag which lies in a spheroidal chamber of corresponding size and form, and, in consequence of the air which they contain, these bags may be seen readily enough shining through the side walls of the skull, the bone of which has a peculiar structure where it surrounds them Now these two bags, which constitute the termination of the air-bladder on each side, are in close relation with the organ of hearing. Indeed, a process of that organ projects into the front chamber on each side, and is separated by only a very delicate partition from the terminal sac of the air-bladder Any vibrations of the air in these sacs, or any change in the pressure of the air in them, must thus tell upon the hearing apparatus

There is no doubt about the existence of these structures which, together with the posterior opening of the air-bladder, were most accurately described, more than sixty years ago, by the eminent anatomist Weber, but I am afraid we are not much wiser regarding their meaning than we were when they were first made known In fishes in general, there can be little doubt that the chief use of the air-bladder is to diminish the specific gravity of the fish and, by rendering its body of nearly the same weight as so much water, to render the business of swimming easier. In those fishes in which the passage of communication between the air-bladder and the alimentary canal is closed, the air is no doubt secreted into the air-bladder by its vessels, which are often very abundant In the herring, the vessels of the air-bladder are very scanty; and it seems probable that the air is swallowed and forced into the air-bladder just as the loach swallows air and drives it into its intestine And, as I have already suggested, it may be that the narrow posterior canal which leads from the air-bladder to the exterior is a sort of safety-valve allowing the air to escape, when the fish, rapidly ascending or descending, alters the pressure of the water upon the contained air

This hypothesis may be put forward with some show of probability, but I really find it difficult to suggest anything with respect to the physiological meaning of the connection between the air-bladder and the ear. Nevertheless such an elaborate apparatus must have some physiological importance, and, this conclusion is strengthened by the well-known fact that there are a great many fishes in which the air-bladder and the ear become connected in one way or another. In the carp tribe, for example, the front end of the air-bladder is connected by a series of little bones with the organ of hearing, which is, as it were, prolonged backwards to meet these bones in the hinder end of the skull But here, the air-bladder, which is very large, may act as a resonator, while, in the herring, the extreme narrowness of the passages which connect the air-bladder with the ear renders it difficult to suppose that the organ can have any such function.

In addition to the singular connection of the ear with the exterior by the roundabout way of the air-bladder, there are membranous spaces in the walls of the skull by which vibrations can more directly reach the herring's ear. And there is no doubt that the fish is very sensitive

[1] See Muller, "Ueber Fische welche Töne von sich geben," *Archiv für Physiologie*, 1857, p 267 The herring is not mentioned in Müller's list of vocal fishes

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Robert Wilhelm Bunsen

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to such vibrations. In a dark night, when the water is phosphorescent or, as the fishermen say, there is plenty of "merefire," it is a curious spectacle to watch the effect of sharply tapping the side of the boat as it passes over a shoal. The herrings scatter in all directions, leaving streaks of light behind them, like shooting stars.

The herring, like other fishes, breathes by means of the gills—the essential part of which consists of the delicate, highly-vascular filaments, which are set in a double row on the outer faces of each of the gill arches. The venous blood which returns from all parts of the body to be collected in the heart, is pumped thence into the gills, and there exchanges its excess of carbonic acid gas for the gaseous oxygen which is dissolved in sea-water The freedom of passage of the water, and the great size and delicacy of the gills, facilitate respiration when the fish is in its native element; but the same peculiarities permitting of the rapid drying and coherence of the gills, and thus bringing on speedy suffocation, render its tenure of life, after removal from the water, as short as that of any fish. It may be observed, in passing, that the wide clefts behind the gill-covers of the herring have some practical importance, as the fish, thrusting its head through the meshes of the drift-net, is caught behind them and cannot extricate itself. In the herring, the upper end of the last gill cleft is not developed into a sac or pouch, such as we shall find in some of its near neighbours

The only other organs of the herring, which need be mentioned at present, are the milt and roe, found in the male and female herring respectively

These are elongated organs attached beneath the air-bladder, which lie, one on each side of the abdominal cavity, and open behind the vent by an aperture common to the two. The spermatic fluid of the male is developed in the milt and the eggs of the female in the roe These eggs, when fully formed, measure from one-sixteenth to one-twenty-fifth of an inch in diameter; and, as, in the ripe female, the two roes or ovaries stretch from one end of the abdominal cavity to the other, occupying all the space left by the other organs, and distending the cavity, the number of eggs which they contain must be very great. Probably 10,000 is an under-estimate of the number of ripe eggs shed in spawning by a moderate-sized female herring. But I think it is safer than the 30,000 of some estimates, which appear to me to be made in forgetfulness of the very simple anatomical considerations that the roe consists of an extensive vascular framework as well as of eggs, and, moreover, that a vast number of the eggs which it contains remain immature, and are not shed at the time of spawning.

In this brief account of the structure of the herring I have touched only on those points which are peculiarly interesting, or which bear upon what I shall have to say by and by An exhaustive study of the fish from this point of view alone would require a whole course of lectures to itself

The herring is a member of a very large group of fishes spread over all parts of the world, and termed that of the *Clupeidæ*, after *Clupea*, the generic name of the herring itself. Our herring, the *Clupea harengus*, inhabits the White Sea and perhaps some parts of the Arctic Ocean, the temperate and colder parts of the Atlantic, the North Sea, and the Baltic, and there is a very similar, if not identical, species in the North Pacific. But it is not known to occur in the seas of southern Europe, nor in any part of the intertropical ocean, nor in the southern hemisphere.

There are four British fishes which so closely resemble herrings, externally and internally, that, though practical men may not be in any danger of confounding them, scientific zoologists have not always succeeded in defining their differences. These are the Sprat, the Allice and Twaite Shads, and the Pilchard.

The sprat comes nearest; indeed young herrings and sprats have often been confounded together, and doubts have been thrown on the specific distinctness of the two. Yet if a sprat and a young herring of the same size are placed side by side, even their external differences leave no doubt of their distinctness The sprat's lower jaw is shorter, the shields in the middle of the belly have a sharper keel, whence the ventral edge is more like a saw; and the ventral fin lies vertically under the front edge of the dorsal fin, or even in front of it, while in the herring, though the position of the ventral fin varies a little, it lies more or less behind the front margin of the dorsal fin. The anal fin is of the same length as the dorsal, in the herring, longer than the dorsal in the sprat But the best marks of distinction are the absence of vomerine teeth in the sprat, and the smaller number of pyloric cæca, which do not exceed nine, their openings being disposed in a single longitudinal series

Shads and pilchards have a common character by which they are very easily distinguished from both sprat and herring There is a horizontal fold of scaly skin on each side of the tail above and below the middle line. Moreover they have no teeth in the inside of the mouth, and their pyloric cæca are very numerous—a hundred or more—their openings being disposed five or six in a row.

The shads have a deep narrow notch in the middle line of the upper jaw, which is absent in the pilchard The intestine of the shad is short and straight, like that of the herring; while that of the pilchard is long and folded several times upon itself

Both of these fishes, again, possess a very curious structure, termed an accessory branchial organ, which is found more highly developed in other fishes of the herring family, and attains its greatest development in a fresh-water fish, the *Heterotis*, which inhabits the Nile This organ is very rudimentary in the shad (in which it was discovered by Gegenbaur[1]), but it is much larger in the pilchard, in which, so far as I know, it has not heretofore been noticed In *Chanos* and several other Clupeoid fishes it becomes coiled upon itself, and in *Heterotis* the coiled organ makes many turns The organ is commonly supposed to be respiratory in function, but this is very doubtful

Herrings which have attained maturity and are distended by the greatly enlarged milt or roe are ready to shed the contents of these organs or, as it is said to spawn. In 1862, we found a great diversity of opinion prevailed as to the time at which this operation takes place, and we took a great deal of trouble to settle the question, with the result which is thus stated in our Report —

"We have obtained a very large body of valuable evidence on this subject, derived partly from the examination of fishermen and of others conversant with the herring fishery, partly from the inspection of the accurate records kept by the fishery officers at different stations, and partly from other sources, and our clear conclusion from all this evidence is, that the herring spawns at two seasons of the year, in the spring and in the autumn We have hitherto met with no case of full or spawning herrings being found, in any locality, during what may be termed the solstitial months, namely June and December; and it would appear that such herrings are never (or very rarely) taken in May or the early part of July, in the latter part of November, or the early part of January But a spring spawning certainly occurs in the latter part of January, in February, in March, and in April; and an autumn spawning in the latter part of July, in August, September, October, and even as late as November Taking all parts of the British coast together, February and March are the great months for the spring spawning, and August and September for the autumn spawning It is not at all likely that the same fish spawn twice in the year, on the contrary, the spring and the autumn shoals are probably perfectly distinct; and if the herring, according to the hypothesis advanced above, come to maturity

[1] "Ueber das Kopfskelet von *Alepocephalus rostratus*," *Morphologisches Jahrbuch*, Bd iv, Suppl 1878

in a year, the shoals of each spawning season would be the fry of the twelvemonth before. However, no direct evidence can be adduced in favour of this supposition, and it would be extremely difficult to obtain such evidence."[1]

I believe that these conclusions, confirmatory of those of previous careful observers[2] are fully supported by all the evidence which has been collected, and the fact that this species of fish has two spawning seasons, one in the hottest and one in the coldest months of the year, is very curious.

Another singular circumstance connected with the spawning of the herring is the great variety of the conditions, apart from temperature, to which the fish adapts itself in performing this function. On our own coasts, herrings spawn in water of from ten to twenty fathoms, and even at greater depths, and in a sea of full oceanic saltness. Nevertheless herrings spawn just as freely, not only in the narrows of the Baltic, such as the Great Belt, in which the water is not half as salt as it is in the North Sea and in the Atlantic, but even in such long inlets as the Schlei in Schleswig, the water of which is quite drinkable and is inhabited by freshwater fish. Here the herrings deposit their eggs in two or three feet of water, and they are found, along with the eggs of freshwater fish, sticking in abundance to such freshwater plants as *Potamogeton*.

Nature seems thus to offer us a hint as to the way in which a fish like the shad, which is so closely allied to the herring, has acquired the habit of ascending rivers to deposit its eggs in purely fresh water.

If a full female herring is gently squeezed over a vessel of sea-water, the eggs will rapidly pour out and sink to the bottom, to which they immediately adhere with so much tenacity that, in half an hour, the vessel may be inverted without their dropping out. When spawning takes places naturally the eggs fall to the bottom and attach themselves in a similar fashion. But, at this time, the assembled fish dart wildly about, and the water becomes cloudy with the shed fluid of the milt. The eggs thus become fecundated as they fall, and the development of the young within the ova sticking to the bottom commences at once.

The first definite and conclusive evidence as to the manner in which herring spawn is attached and becomes developed that I know of, was obtained by Prof. Allman and Dr. MacBain in 1862,[3] in the Firth of Forth. By dredging in localities in which spent herring were observed on the 1st of March, Professor Allman brought up spawn in abundance at a depth of fourteen to twenty-one fathoms. It was deposited on the surface of the stones, shingle, and gravel, and on old shells and coarse shell-sand, and even on the shells of small living crabs and other crustacea, adhering tenaciously to whatever it had fallen on. No spawn was found in any other part of the Forth, but it continued to be abundant on both the east and the west sides of the Isle of May up to the 13th of March, at which time the incubation of the ovum was found to be completed in a great portion of the spawn, and the embryos had become free. On the 25th scarcely a trace of spawn could be detected, and nearly the whole of the adult fish had left the Forth.

Prof. Allman draws attention to the fact "that the deposit of spawn, as evidenced by the appearance of spent herrings, did not take place till about sixty-five days after the appearance of the herring in the Firth," and arrives at the conclusion that "the incubation probably continues during a period of between twenty-five to thirty days," adding however that the estimate must for the present be regarded as only approximative. It was on this and other evidence that we based our conclusion that the eggs of the herring "are hatched in at most from two to three weeks after deposition."

Within the last few years a clear light has been thrown upon this question by the labours of the West Baltic Fishery Commission, to which I have so often had occasion to refer.[1] It has been found that artificial fecundation is easily practised, and that the young fish may be kept in aquaria for as long as five months. Thus, a great body of accurate information, some of it of a very unexpected character, has been obtained respecting the development of the eggs, and the early condition of the young herring.

It turns out that, as is the case with other fishes, the period of incubation is closely dependent upon warmth. When the water has a temperature of 53° Fahrenheit, the eggs of the herring hatch in from 6–8 days, the average being seven days. And this is a very interesting fact when we bear in mind the conclusion to which the inquiries of the Dutch meteorologists, and, more lately, those of the Scottish Meteorological Society appear to tend, namely, that the shoals prefer water of about 55°. At 50° Fahrenheit, the period of incubation is lengthened to eleven days, at 46° to fifteen days; and at 38° it lasts forty days. As the Forth is usually tolerably cool in the month of March, it is probable that Prof. Allman's estimate comes very near the truth for the particular case which he investigated.

The young, when they emerge from the egg, are from one-fifth to one-third of an inch in length, and so extremely unlike the adult herring that they may properly be termed larvæ. They have enormous eyes and an exceedingly slender body, with a yelk bag protruding from its forepart. The skeleton is in a very rudimentary condition, there are no ventral fins, and instead of separate dorsal, caudal, and anal fins, there is one continuous fin extending from the head along the back, round the tail, and then forwards to the yelk bag. The intestine is a simple tube, ciliated internally, there is no air-bladder, and no branchiæ are yet developed. The heart is a mere contractile vessel, and the blood is a clear fluid without corpuscles. At first the larvæ do not feed, but merely grow at the expense of the yelk, which gradually diminishes.

Within three or four days after hatching, the length has increased by about half the original dimensions, the yelk has disappeared, the cartilaginous skeleton appears, and the heart becomes divided into its chambers; but the young fish attains nearly double its first length before blood corpuscles are visible.

By the time the larva is two-thirds of an inch long (a length which it attains one month after hatching), the primitive median fin is separated into dorsal, caudal, and anal divisions, but the ventral fins have not appeared. About this period the young animal begins to feed on small crustacea; and it grows so rapidly that, at two months, it is 1¼ inch long, and, at three months, has attained a length of about two inches.

Nearly up to this stage the elongated scaleless little fish retains its larval proportions; but, in the latter part of the third month, the body rapidly deepens, the scales begin to appear, and the larva passes into the "imago" state—that is, assumes the form and proportions of the adult, though it is not more than two inches long. After this, it goes on growing at the same rate (11 millimetres, or nearly half an inch) per month, so that, at six months old, it is as large as a moderate-sized sprat.

The well-known "whitebait" of the Thames consists,

[1] "Report of the Royal Commission on the operation of the Acts relating to Trawling for Herrings on the Coast of Scotland (1863)," p. 28.

[2] Brandt and Ratzeburg, for example, in 1833 strongly asserted that the herring has two spawning seasons.

[3] "Report of the Royal Commission on the Operation of the Acts relating to Trawling for Herring on the Coast of Scotland, 1863."

[1] See the four valuable memoirs, Kupffer, "Ueber Laichen und Entwickelung des Herings in der westlichen Ostsee"; *Idem*, "Die Entwickelung des Herings im Ei"; Meyer, "Beobachtungen über den Wachsthum des Herings"; Heincke, "Die Varietäten des Herings," which are contained in the *Jahresbericht der Commission in Kiel für* 1874-75-76 – 1878. Widegren's essay "On the Herring," 1871, translated from the Danish in U.S. Commission Reports, 1873–75, also contains important information.

so far as I have seen, almost exclusively of herrings, under six months old, and as the average size of whitebait increases, from March and April onwards, until they become suspiciously like sprats in the late summer, it may be concluded that they are the progeny of herrings which spawned, early in the year, in the neighbourhood of the estuary of the Thames, up which these dainty little fish have wandered. Whether it is the general habit of young herring, even of those which are spawned in deep water, to migrate into the shallow parts of the sea, or even into completely fresh waters, when such are accessible, is unknown.

In the Report on Trawling (1863) we observe:—

"It is extremely difficult to obtain any satisfactory evidence as to the length of time which the herring requires to pass from the embryonic to the adult or *full* condition. Of the fishermen who gave any opinion on this subject, some considered that a herring takes three, and others that it requires seven, years to attain the full or spawning condition, others frankly admitted that they knew nothing about the matter, and it was not difficult, by a little cross-examination, to satisfy ourselves that they were all really in this condition, however strongly they might hold by their triennial or septennial theories. Mr Yarrell and Mr Mitchell suppose with more reason that herring attain to full size and maturity in about eighteen months.

"It does not appear, however, that there is any good evidence against the supposition that the herring reaches its spawning condition in one year. There is much reason to believe that the eggs are hatched in, at most, from two to three weeks after deposition, and that in six to seven weeks more (that is at most ten weeks from the time of laying the eggs) the young have attained three inches in length. Now it has been ascertained that a young smolt may leave a river and return to it again in a couple of months increased in bulk eight or tenfold, and as a herring lives on very much the same food as a smolt, it appears possible that it should increase in the same rapid ratio. Under these circumstances nine months would be ample time for it to enlarge from three to ten or eleven inches in length. It may be fairly argued, however, that it is not very safe to reason analogically from the rate of growth of one species of fish to that of another; and it may be well to leave the question whether the herring attains its maturity in twelve, fifteen, or sixteen months open, in the tolerably firm assurance that the period last named is the maximum."

On comparing these conclusions with the results of the careful observations of the Baltic Commissioners, it appears that we somewhat over-estimated the rate of growth of the young herring, and that the view taken by Yarrell and Mitchell is more nearly correct. For supposing that the rate of growth after six months continues the same as before, a herring twelve months old will be nearly six inches long, and at eighteen months eight or nine inches. But full herrings may be met with little more than seven inches long, and they are very commonly found not more than nine inches in length.[1]

Fishermen distinguish four states of the herring. Fry or sile, when not larger than sprats; maties, when larger than this, with undeveloped roe or milt; full fish, with largely developed roe or milt; and spent or shotten fish, which have recently spawned.

Herring fry of the size of sprats are distinguished from full fish not merely by their size, but in addition, by the very slight development of the milt or roe, and by the accumulation of fat in the abdominal cavity. Bands of fat are found in the mesentery alongside the intestine, and filling up the interspaces between the pyloric cæca.

[1] Ljungman ("Preliminary Report on Herrings and Herring Fisheries on the West Coast of Sweden," translated in U S Commission Report, 1873-5) speaks of full herrings ready to spawn only 100-110 mm. (4 to 4½ in.) long, as observed by himself.

Maties (the name[1] of which is a corruption of the Dutch word for a maiden) resemble the fry in these particulars; but, if they are well fed, the deposit of fatty and other nutritive matter takes place, not only about the abdominal viscera, but also beneath the skin and in the interstices of the flesh. Indeed, when nourishment is abundant, this infiltration of the flesh with fat may go so far that the fish cannot readily be preserved and must be eaten fresh. The singularly delicate Loch Fyne herrings are in this condition early in the season. When the small crustaceans, on which the maties chiefly feed, are extremely abundant the fish gorge themselves with them to such an extent that the conical crop becomes completely distended, and the Scotch fishermen give them the name of "gut-pock herrings," as much as to say pouch-gutted fish, and an absurd notion is current that these herrings are diseased. However, the "gut-pock" herrings differ from the rest only in having their pouch full instead of empty, as it commonly is.

As the fish passes from the matie to the full condition, the milt and roe begin to grow at the expense of the nutriment thus stored up; and, as these organs become larger and occupy more and more space in the abdominal cavity, the excess of nutritious substance is transferred to them. The fatty deposit about the intestine and pyloric cæca gradually disappears and the flesh becomes poorer. It would appear that by degrees the fish cease to feed at all. At any rate, there is usually no food in the stomach of a herring which approaches maturity. In all these respects there is the closest resemblance between the history of the herring and that of other fishes such as the salmon—the parr correspnding to the herring fry or sile, the grilse and the "clean fish" of larger size to the maties.

At length spawning takes place, the accumulated nutrition, transformed into eggs or spermatic fluid, is expelled, and the fish is left in that lean and depauperated state which makes a "shotten herring" proverbial. In this condition it answers to the salmon "kelt," and the milt or roe are now shrunk and flaccid and can be blown up with air like empty bags. If the spent fish escapes its myriad enemies, it doubtless begins to feed again and once more passes into the matie state in preparation for the next breeding season. But the nature of this process of recuperation has yet to be investigated.

When they have reached the matie stage, the herrings, which are at all times gregarious, associate together in conspicuous assemblages, which are called shoals. These are sometimes of prodigious extent—indeed eight or nine miles in length, two or three in breadth, with an unknown depth, are dimensions which are credibly asserted to be sometimes attained. In these shoals the fish are closely packed, like a flock of sheep straying slowly along a pasture, and it is probably quite safe to assume that there is at least one fish for every cubic foot of water occupied by the shoal. If this be so, every square mile of such a shoal, supposing it to be three fathoms deep, must contain more than 500,000,000 herrings. And when it is considered that many shoals approach the coasts, not only of our own islands, but of Scandinavia and the Baltic, and of Eastern North America, every spring and autumn, the sum total of the herrings which people our seas surpasses imagination.

If you read any old and some new books on the natural history of the herring, you will find a wonderful story about the movements of these shoals. How they start from their home in the Polar Seas, and march south as a great armada which splits into minor divisions—one destined to spawn on the Scandi-

[1] "Halecum Intestina, non modo multa gaudere obesitate, sed et totum corpus eo adeo esse impletum ut aliquando, cum discinditur, pinguedo ex cultro defluat, et præsertim eo quidem tempore ubi halecum lactes aut ova crescere primum incipiunt, unde nostrates eos *Maatgens-Harringen* dicere solent"—A v Leeuwenhoek, "Arcana Naturæ," Ep xcvii (1696)

Leeuwenhoek also mentions having heard of "gut pock" herrings from Scotch fishermen.

navian, and one on our own shores; and how, having achieved this spawning raid, the spent fish make their way as fast as they can back to their Arctic refuge, there to repair their exhausted frames in domestic security. This story was started in the last century, and was unfortunately adopted and disseminated by our countryman Pennant. But there is not the least proof that anything of the kind takes place, and the probabilities are wholly against it. It is, for example, quite irreconcilable with the fact that herring are found in cods' stomachs all the year round. And the circumstance to which I have already adverted, that practised eyes distinguish local breeds of herrings, though it does not actually negative the migration hypothesis, is very much against it. The supposition that the herring spawn in the north in the early spring, and in the south in the autumn, fitted very well into the notion that the vanguard of the migrating body of herrings occupied the first spawning ground it reached, and obliged the rest of the horde to pass on. But, as a matter of fact, the northern herrings, like the southern, have two spawning times, or perhaps it would be more correct to say that the spawning time extends from autumn to spring, and has two maxima—one in August-September, and one in February-March.

Finally, there is no evidence that herrings are to be met with in the extreme north of their range, at other times, or in greater abundance, than they are to be found elsewhere.

In the matter of its migration, as in other respects, the herring compares best with the salmon. The ordinary habitation of both fishes is no doubt the moderately deep portion of the sea. It is only as the breeding time draws near that the herrings (not yet advanced beyond the matie state) gather together towards the surface and approach the land in great shoals for the purpose of spawning in relatively or absolutely shallow water. In the case of the herring of the Schlei we have almost the connecting link between the exclusively marine ordinary herring and the river ascending salmon.

The records of the herring fisheries are, for the most part, neither very ancient nor (with the exception of those of the Scotch Fishery Board) very accurately kept, and, from the nature of the case, they can only tell us whether the fish in any given year were readily taken or not, and that may have very little to do with the actual strength of the shoals.

However, there is historical evidence that, long before the time of Henry the First, Yarmouth was frequented by herring fishers. This means that, for eight centuries, herrings have been fished on the English coast, and I cannot make out, taking one year with another, in recent times, that there has been any serious fluctuation in their numbers. The number captured must have enormously increased in the last two centuries, and yet there is no sign of diminution of the shoals.

In 1864, we had to listen to dolorous prophecies of the coming exhaustion of the Scotch herring fisheries. The fact that the returns showed no falling off was ascribed to the improvement of the gear and methods of fishing, and to the much greater distances to which the fishermen extend their operations. Yet what has really happened? The returns of subsequent years prove, not only that the average cure of the decade 1869-78 was considerably greater than that of the previous decade, but that the years 1874 and 1880 are absolutely without parallel in the annals of the Scotch herring fishery, a million barrels having been cured in the first of these years, and a million and a half in 1880. In the decade 1859-68, the average was 670,000 barrels, and the highest 830,000.

In dealing with questions of biology, *à priori* reasoning is somewhat risky, and if any one tells me "it stands to reason" that such and such things must happen, I generally find reason to doubt the safety of his standing.

It is said that "it stands to reason" that destruction on such a prodigious scale as that effected by herring fishers must tell on the supply. But again let us look at the facts. It is said that 2,500,000,000, or thereabouts, of herrings are every year taken out of the North Sea and the Atlantic. Suppose we assume the number to be 3,000,000,000 so as to be quite safe. It is a large number undoubtedly, but what does it come to? Not more than that of the herrings which may be contained in one shoal, if it covers half a dozen square miles—and shoals of much larger size are on record. It is safe to say that, scattered through the North Sea and the Atlantic, at one and the same time, there must be scores of shoals, any one of which would go a long way towards supplying the whole of man's consumption of herrings. I do not believe that all the herring fleets taken together destroy 5 per cent. of the total number of herrings in the sea in any year, and I see no reason to swerve from the conviction my colleagues and I expressed in our Report, that their destructive operations are totally insignificant when compared with those which, as a simple calculation shows, must regularly and normally go on.

Suppose that every mature female herring lays 10,000 eggs, that the fish are not interfered with by man, and that their numbers remain approximately the same year after year, it follows that 9998 of the progeny of every female must be destroyed before they reach maturity. For if more than two out of the 10,000 escape destruction, the number of herrings will be proportionately increased. Or in other words, if the average strength of the shoals which visit a given locality is to remain the same year by year, many thousand times the number contained in those shoals must be annually destroyed. And how this enormous amount of destruction is effected will be obvious to any one who considers the operations of the fin-whales, the porpoises, the gannets, the gulls, the codfish, and the dogfish, which accompany the shoals and perennially feast upon them, to say nothing of the flat-fish, which prey upon the newly-deposited spawn; or of the mackerel, and the innumerable smaller enemies which devour the fry in all stages of their development. It is no uncommon thing to find five or six—nay, even ten or twelve—herrings in the stomach of a codfish,[1] and, in 1863, we calculated that the whole take of the great Scotch herring fisheries is less than the number of herrings which would in all probability have been consumed by the codfish captured in the same waters if they had been left in the sea.[2]

Man, in fact, is but one of a vast co-operative society of herring-catchers, and the larger the share he takes, the less there is for the rest of the company. If man took none, the other shareholders would have a larger dividend, and would thrive and multiply in proportion, but it would come to pretty much the same thing to the herrings.

As long as the records of history give us information, herrings appear to have abounded on the east coast of the British Islands, and there is nothing to show, so far as I am aware, that, taking an average of years, they were ever either more or less numerous than they are at present. But in remarkable contrast with this constancy, the shoals of herrings have elsewhere exhibited a change capriciousness—visiting a given locality for many years in great numbers, and then suddenly disappearing. Several well-marked examples of this fickleness are recorded on the west coast of Scotland; but the most remarkable is that furnished by the fisheries of Bohuslan, a province which lies on the south-western shore of the Scandinavian peninsula. Here a variety known as the "old" or

[1] In his valuable Report on the Salt Water Fisheries of Norway (1877), Prof. Sars expresses the belief that full-grown codfishes feed chiefly, if not exclusively, on herrings.

[2] In 1879 rather more than 5,000,000 cod, ling, and hake, were taken by the Scottish fishermen. Allowing each only two herrings a day, these fishes would have consumed more than three thousand five hundred million of herrings in a year. As to the Norwegian fisheries, 20,000,000 codfishes are said to be taken annually by the Lofoden fishermen alone.

"great" herring, after being so extremely abundant, for about sixty years, as to give rise to a great industry, disappeared in the year 1808, as suddenly as they made their appearance, and have not since been seen in any number.

The desertion of their ordinary grounds by the herring has been attributed to all imaginable causes, from fishing on a Sunday to the offence caused to the fish by the decomposing carcases of their brethren, dropped upon the bottom out of the nets. The truth is that absolutely nothing is known on the subject, and that little is likely to be known, until careful and long-continued meteorological and zoological observations have furnished definite information respecting the changes which take place in the temperature of the sea, and the distribution of the pelagic crustacea which constitute the chief food of the herring shoals. The institution of systematic observations of this kind is an object of international importance, towards the attainment of which the British, Scandinavian, Dutch, and French Governments might wisely make a combined effort.

A great fuss has been made about trawlers working over the spawning grounds of the herring. "It stands to reason," we were told, that they must destroy an immense quantity of the spawn. Indeed this looked so reasonable, that we inquired very particularly into a case of the alleged malpractice which was complained of on the east coast of Scotland, near Pittenweem. Off this place, there is a famous spawning ground known as the Traith hole, and we were told that the trawlers worked vigorously over the spot immediately after the herring had deposited their spawn. Of course our first proceeding was to ask the trawlers why they took the trouble of doing what looked like wanton mischief. And their answer was reasonable enough. It was to catch the prodigious abundance of flat-fish which were to be found on the Traith at that time. Well, then, why did the flat-fish congregate there? Simply to feed on herring eggs, which seem to be a sort of flat-fishes' caviare. The stomachs of the flat-fish brought up by the trawl were, in fact, crammed with masses of herring eggs.

Thus every flat-fish caught by the trawl was an energetic destroyer of herring arrested in his career. And the trawling, instead of injuring the herring, captured and removed hosts of their worst enemies. That is how "it stood to reason" when one got to the bottom of the matter.

I do not think that any one who looks carefully into the subject will arrive at any other conclusion than that reached by my colleagues and myself, namely, that the best thing for Governments to do in relation to the herring fisheries, is to let them alone, except in so far as the police of the sea is concerned. With this proviso, let people fish how they like, as they like, and when they like. At present, I must repeat the conviction we expressed so many years ago, that there is not a particle of evidence that anything man does has an appreciable influence on the stock of herrings. It will be time to meddle, when any satisfactory evidence that mischief is being done is produced.

NOTES

The fifty first Annual Meeting of the British Association for the Advancement of Science will commence at York on Wednesday, August 31, 1881. The President-Elect is Sir John Lubbock, Bart, M.P., F.R.S. Vice-Presidents Elect: His Grace the Archbishop of York, D.D., F.R.S.; the Right Hon. the Lord Mayor of York; the Right Hon. Lord Houghton, F.R.S.; the Ven. Archdeacon Creyke, M.A., the Hon. Sir W. R. Grove, F.R.S.; Prof. G. G. Stokes, Sec. R.S.; Sir John Hawkshaw, C.E., F.R.S.; Allen Thomson, M.D., F.R.S. L. and E.; Prof. Allman, M.D., F.R.S. L. and E. General Secretaries: Capt. Douglas Galton, C.B., D.C.L., F.R.S.; Philip Lutley Sclater, Ph.D., F.R.S. Acting Secretary: George Griffith, M.A., F.C.S., Harrow. General Treasurer: Prof. A. W. Williamson, F.R.S., University College, London, W.C. Local Secretaries: Rev. Thomas Adams, M.A., Tempest Anderson, M.D., B.Sc., York. Local Treasurer: W. W. Wilberforce, York. The Sections are the following:—A.—Mathematical and Physical Science.—President: Prof. Sir William Thomson, F.R.S. L. and E. Vice Presidents.—Prof. J. C. Adams, F.R.S., T. Archer Hirst, Ph.D., V.P.R.S. Secretaries: Prof. W. E. Ayrton, Oliver J. Lodge, D.Sc., Donald McAlister, B.A., B.Sc. (Recorder). B.—Chemical Science.—President: Prof. A. W. Williamson, For. Sec. R.S., V.P.C.S. Vice-Presidents: F. A. Abel, C.B., F.R.S.; Prof. Odling, F.R.S. Secretaries: Harold B. Dixon, M.A.; P. Phillips-Bedson, D.Sc. (Recorder). C.—Geology.—President: Andrew Crombie Ramsay, LL.D., F.R.S., Director-General of the Geological Survey of the United Kingdom and of the Museum of Practical Geology. Vice Presidents: Prof. Prestwich, F.R.S., Prof. W. C. Williamson, F.R.S.; Secretaries: W. Topley, F.G.S. (Recorder); W. Whitaker, F.G.S. D.—Biology.—President: Richard Owen, C.B., F.R.S. Vice-Presidents: Prof. W. H. Flower, F.R.S.; Prof. J. S. Burdon Sanderson, F.R.S. Secretaries: G. W. Bloxam, M.A., F.L.S., W. L. Distant, W. A. Forbes, F.Z.S., Prof. M'Nab, M.D.; John Priestley, Howard Saunders, F.L.S., F.Z.S. Department of Zoology and Botany.—Richard Owen, C.B., F.R.S. (President), will preside. Secretaries: Prof. M'Nab, M.D. (Recorder), Howard Saunders, F.L.S., F.Z.S. Department of Anthropology.—Prof. W. H. Flower, F.R.S. (Vice-President), will preside. Secretaries: G. W. Bloxam, M.A., F.L.S. (Recorder), W. L. Distant. Department of Anatomy and Physiology.—Prof. J. S. Burdon Sanderson, F.R.S. (Vice-President), will preside. Secretaries: John Priestley (Recorder); W. A. Forbes, F.Z.S. E.—Geography.—President: Sir J. D. Hooker, K.C.S.I., C.B., F.R.S. Vice-Presidents: Francis Galton, F.R.S., Prof. Sir C. Wyville Thomson, F.R.S. L. & E. Secretaries: H. W. Bates, Assist.-Sec. R.G.S., F.L.S.; E. C. Rye, Librarian R.G.S., F.Z.S. (Recorder). F.—Economic Science and Statistics.—President: The Right Hon. M. E. Grant Duff, M.P., F.R.S. Vice-Presidents: Sir George Campbell, K.C.S.I., M.P.; James Heywood, F.R.S. Secretaries: Constantine Molloy (Recorder), J. F. Moss. G.—Mechanical Science.—President: Sir W. G. Armstrong, C.B., F.R.S. Vice Presidents: W. H. Barlow, F.R.S., Pres. Inst. C.E.; C. W. Siemens, D.C.L., F.R.S. Secretaries: A. T. Atchison, M.A. (Recorder), H. Trueman Wood, B.A. Tickets for the meeting may be obtained of the Local Secretaries at York, and at the Office of the Association, 22, Albemarle Street, London, W., or on application by letter, from August 17 to August 24, to the General Treasurer, Prof. A. W. Williamson, British Association, University College, London, W.C. The First General Meeting will be held on Wednesday, August 31, at 8 p.m. precisely, when A. C. Ramsay, F.R.S., V.P.G.S., Director-General of the Geological Survey of the United Kingdom, and of the Museum of Practical Geology, will resign the chair, and Sir John Lubbock, Bart., M.P., F.R.S., President-Elect, will assume the presidency, and deliver an address. On Thursday evening, September 1, at 8 p.m., a *soirée*, on Friday evening, September 2, at 8.30 p.m., a discourse by T. H. Huxley, LL.D., Sec.R.S., Professor of Natural History in the Royal School of Mines, on Monday evening, September 5, at 8.30 p.m., a discourse by W. Spottiswoode, D.C.L., LL.D., President of the Royal Society, on Tuesday evening, September 6, at 8 p.m., a *soirée*; on Wednesday, September 7, the concluding general meeting will be held at 2.30 p.m. No report, paper, or abstract, can be inserted in the Report of the Association unless it is given in before the conclusion of the meeting. Excursions to places of interest in the neighbourhood of York

will be made on the afternoon of Saturday, September 3, and on Thursday, September 8.

THE honorary degree of LL.D. has been conferred on the following gentlemen by the University of Glasgow:—F. M Balfour, M A, Fellow of Trinity College, Cambridge, Dr. Angus Smith, F.R.S., Government Inspector of Alkali Works; Prof. Richard Owen, C.B, F.R.S., Superintendent of Natural History Collections of the British Museum, Andrew Buchanan, M.D., Emeritus Professor of Physiology in the University of Glasgow.

THE honorary degree of LL.D. has been conferred by the University of Edinburgh on Prof. A. W Williamson, of University College, London.

IT is intended to celebrate in Edinburgh the centenary of the birthday of Sir David Brewster, on December 9, by a public dinner.

THE annual meeting of the Iron and Steel Institute will be held in London on May 4, 5, and 6 On May 4 the Bessemer Medal for 1881 will be presented to Mr. William Menelaus, and the president-elect (Mr. Josiah T. Smith) will deliver his inaugural address The following is the list of papers to be read — On the Results of Experiments relative to Corrosion in Iron and Steel, by Mr. William Parker of Lloyd's Registry, London; On the Manufacture of Armour Plates, by Mr Alexander Wilson, Sheffield, On the Manufacture of Steel and Steel Plates in Russia, by Mr. Sergius Kern, St. Petersburg; On the Use of Steel for Shipbuilding, by Mr. William Denny, Dumbarton, On some Physical Properties of Cast Iron, by Mr Charles Markham, Staveley, On the Desulphurisation of Iron, by M. Rollet, St Chamond, France, On Iron and Steel Permanent Way, by Mr. R Price Williams, London, On Hydraulic Appliances for the Bessemer Process, by Mr. Michael Scott, London, On the Manufacture of Bessemer Steel and Steel Rails in America, by Capt. Jones, Edgar Thomson Steel Works, Pittsburg, U S A., On Hydrogen and Carbonic Oxide in Iron and Steel, by Mr. John Parry, Ebbw Vale, On the Preservation of Iron and Steel Surfaces, by Mr George Bower, St. Neots, On a new method for the determination of Oxygen in Iron and Steel, by Mr. Alex E. Tucker, Rhymney.

DURING the Summer Term of the City and Guilds of London Institute, commencing May 2, 1881, Prof. Armstrong, Ph.D, F R.S, and Prof Ayrton, A.M, Inst.C E, will continue their tutorial and laboratory courses of instruction in chemistry and physics as applied to the arts and manufactures, at the Cowper Street Schools, pending the present erection of the City and Guilds of London Technical College, Finsbury, the foundation stone of which will be laid by Prince Leopold on May 10. There are both day and evening classes at the institute, with means for ample laboratory practice, at fees which place the education within reach of all classes. We would specially draw attention to the fact that these classes and the laboratory practice are open, at an almost nominal fee, to female as well as to male students. For every hour of lecture there are two hours laboratory work included in this nominal fee. The day classes would be of service to girls who have not the means to obtain a Girton or a Newnham education, while the evening classes will be of great use to those women who take more than a mechanical interest in their daily work; for from the course of instruction and their own work in the laboratory they will gain such a thorough knowledge of principles as should distinguish a skilled workwoman from a mere machine.

THE Annual Report for the past year of the Jamaica Public Gardens, by Mr. D. Morris, the new director, is one of great interest. As the year has been the first under the new organisation, the chief work has naturally been of a departmental character, but from the details given, it is evident that important advances have been made in developing several industries which must have an important influence for good on the future of the island. From the variation in altitude of the different gardens under Mr. Morris's charge excellent opportunities are afforded for experimenting on various kinds of cultivation, and these he is evidently prepared to take full advantage of. Among the various cultures, concerning which interesting information is contained in the Report, are Cinchona, Liberian Coffee, Sugar Canes, Teak and Mahogany, Pine-Apples, Jalap, Cacao, Tobacco, India-Rubber, various spices, Oranges, Banana Fibre, &c. The best results may be looked for from Mr. Morris's vigorous and intelligent directorship.

WE have also a very satisfactory Report of work for the year ending March 31, 1880, from Mr. Duthie, superintendent of the Government Botanical Gardens at Saharanpor and Mussooree As in Jamaica, experiments, some of them very successful, have been carried on in the rearing of various useful plants, including vegetable and medicinal plants Much difficulty has been experienced by Mr Duthie in training *Mallies* for work in the gardens, and he has some trials before him ere he is able to turn out a staff of properly-trained natives.

MR M. G. MULHALL sends us the following curious note, which we give without comment:—"Although Shakespeare is supposed to have taken the idea of Hamlet from the Danish historian Saxo-Grammaticus, there are such points of resemblance with the Arabic chronicle of Nigiaristan, respecting Montasser, tenth Caliph of Bagdad, that I venture to call your attention to the same. The points of analogy are as follows: 1. That Montasser is murdered by putting poison in his ear. 2. The ghost scene, in which his father appears to him. 3. The displaying of tapestry before the Caliph and his court, in which the tapestry represents a tragedy identical with the late Caliph's murder"

THE *Daily News* New York correspondent telegraphs that the aldermen have passed, over the mayor's veto, the ordinance giving the Edison Electric Lighting Company permission to lay tubes in the streets "The company will proceed immediately to introduce its new electric lamps in the offices in the business portion of the city around Wall Street. The construction of the lamp is simple. It consists of a small bulbous glass globe, four inches long, an inch and a half in diameter, with a carbon loop which becomes incandescent when the electric current passes through. Each lamp is of sixteen candle power, with no perceptible variation in intensity. The light is turned on or off with a thumbscrew. Wires have already been put into forty buildings. The company will compete with the gas compan s by charging the same rates. If the latter reduce, the I on Company will also reduce, and are prepared to go lower than the gas companies can."

AT five o'clock on Saturday morning a strong shock of earthquake was felt at Paola in the province of Calabria. On the night of April 19 there was another severe shock of earthquake at Chios

A NEW illustrated work on the Butterflies of Europe is, we understand, in active preparation by Dr. Lang, F.L.S. Its publication, in monthly parts, will be commenced very shortly by Messrs. Lovell, Reeve, and Co.

MRS. BURTON, the wife of the well known Capt. R. Burton, our Consul at Trieste, is evidently doing a good work in that city in teaching the people kindness to animals. The lesson is evidently much needed, and judging from Mrs. Burton's speech at her last fête and distribution of prizes, her efforts are meeting with decided success. Of course all this costs money; possibly some of our readers may be inclined to help by sending a con-

tribution to Mrs. Richard Burton, British Consulate, Trieste, Austria.

OWING to the outcry caused by the sale to a private person of the Katoomba Falls, in the Blue Mountains, the New South Wales Government, according to the *Colonies and India*, has set apart for public use large tracts of land round Dangar's Falls, near Armidale, the Great Falls in the same district, and Moona Falls, near Walcha, in imitation of the reserves or national parks in the United States of America.

A REMARKABLE frost is said to have occurred in Guatemala on February 10, doing great damage to the tropical vegetation.

IN the review of Messrs Fison and Howitt's "Kamilaroi and Kurnai" that appeared last week, we should have mentioned that the book is published in England by Messrs Macmillan and Co.

FROM Glasgow we have received two satisfactory Reports—that of the Industrial Museum, presided over by Mr James Paton, and that of the Mitchell Library, under Mr. F. T. Barrett

TWO HUNDRED AND TEN school teachers nominated on purpose by the 30,000 public teachers of elementary schools in France, and travelling at the expense of the Government, were summoned to Paris in order to hold a Pedagogic Congress, which came to a close on the 24th At the same time the Ligue de l'Enseignement, founded by M. Jean Macé, held a series of meetings at the Trocadero. The concluding sitting, which took place last Thursday, was attended by all the school teachers and an immense number of political leaders M. Gambetta delivered a speech praising the advantages of education, commending school teachers as a body, and advocating the importance of interesting ladies in the general diffusion of knowledge.

MESSRS. MARSHALL JAPP, AND CO, have published a useful little Half-Holiday Handbook of Geological Rambles around London, which will be found to add much interest to a Saturday afternoon walk into the country

MR H. L JANSSEN VAN RAAY writes to us from Batavia, March 21, that in the enumeration of the different geographical societies of the world in NATURE, vol. xxiii p. 299, the Geographical Society at Samarang (Java), founded in 1879, was omitted.

FIDELIS BUTSCH SOHN of Augsburg has issued a priced catalogue of the extensive library of the late Prof. W. P. Schimper of Strassburg

THE new number of the *Proceedings* of the Bristol Natural History Society contains some good papers —Some Optical Illusions, by Prof. S. P Thompson, Underground Temperature, by Mr E. Wethered; The Structure and Life-History of a Sponge, by Mr. W. G. Sollas, On some Cases of Prolification in *Cyclamen Persicum*, by Mr. A. Leipner, The Ethnology of the Paropamisus, by Dr J. Beddoe, F R.S, Catalogue of the Lepidoptera of the Bristol District, by Mr. A. E. Hudd, and of the Fungi, by Mr. C Bucknall; The Pomarine Skua, by M H. Charbonnier.

THE additions to the Zoological Society's Gardens during the past week include three Short-tailed Wallabys (*Halmaturus brachyurus*) from West Australia, presented by Sir Harry St. George Ord, C.B., H.M Z S.; three Green Lizards (*Lacerta viridis*) from Jersey, presented by Mr. E. H Bland; a Rufous Rat Kangaroo (*Hypsiprymnus rufescens*) from Australia, presented by Mr. A. W. Wyatt; a Lion (*Felis leo* ♀) from Africa, deposited; three Entellus Monkeys (*Semnopithecus entellus* ♂ ♂ ♀) from India, purchased, a Lion (*Felis leo* ♀) from Africa, a Common Otter (*Lutra vulgaris* ♀), British, received in exchange; a Collared Fruit Bat (*Cynonycteris collaris*), a Vulpine Phalanger (*Phalangista vulpina*), born in the Gardens.

CHEMICAL NOTES

IN *Journal pract Chemie*, Herr Cech, in the course of a paper on the decompositions which occur during the rotting of eggs, describes experiments which he thinks establish the possibility of obtaining a good soap free from smell, by saponifying with soda the residue obtained by evaporating to dryness rotten eggs, freed from their shells Such a dried residue yields about 10·5 per cent of oil, fresh eggs giving about 11 per cent.

THE changes undergone by grain when stored in underground magazines have been recently studied by M Muntz (*Compt rend*). The magazines of the Paris Omnibus Company are partly underground, the grain in the upper parts is, however, exposed to the influence of atmospheric changes, it is found to contain much more moisture and to be at a higher temperature than that in the lower parts The relative amounts of deterioration in grains may be measured by the quantities of carbonic anhydride exhaled When grain is freely exposed to air about ten times as much carbonic anhydride is given off as when the grain is kept in closed receptacles, less oxygen is absorbed than corresponds with this evolution of carbon dioxide Normal grain contains from 11 to 19 per cent. of moisture. the greater the moisture the greater the exhalation of carbon dioxide The amount of the gas evolved also increases with increase of temperature until a point is reached at which true chemical combustion of the carbon begins, as distinguished from the physiological combustion which has preceded it Grain which is to be kept for any time ought to be very dry, the receptacle containing it ought to be completely closed, and all parts of this receptacle ought to be at approximately the same temperature.

MR. V. LEWES, in the same journal, describes barium pentathionate, $BaS_5O_6 . 3H_2O$, and several potassium pentathionates, prepared by slow evaporation in a vacuum of "Wackenroder's solution" These experiments appear to establish beyond doubt the existence of pentathionic acid.

DRS. DUPRÉ AND HAKE have applied their method for the estimation of carbon (*Chem Soc Journ*)—viz. burning in oxygen, absorbing carbonic anhydride in baryta water, converting the barium carbonate into sulphate, and weighing as such—to the estimation of carbon in air; their experiments apparently demonstrate the presence in London air of carbon in forms other than carbonic anhydride, and probably in the form of some volatile organic compounds, not as suspended matter. Drs. Dupré and Hake claim that their method of analysis enables them to estimate carbonic anhydride, carbon in the peculiar forms already noticed, and suspended carbonaceous matter in air.

IN the same journal there is a contribution to the history of ozone by Prof. Hartley of Dublin. The main conclusions drawn from experimental data are these · Ozone is a normal constituent of the higher atmosphere, and is present therein in larger proportion than near the surface of the earth The limitation of the solar spectrum in the ultra-violet is readily accounted for by the absorptive action of atmospheric ozone, without taking into account the possible absorptive power of nitrogen and oxygen. The blue tint of the atmosphere is probably due to ozone. It is shown in the paper that the wave-length of the extreme ray capable of absorption by considerable quantities of ozone is about 316 A quantity of 2·5 mgm. of ozone in each square centimetre of sectional area of a column of air produces, it is said, a full sky-blue tint. Incidentally experiments are described in which one volume of ozone was distinctly detected by the sense of smell in 2,500,000 volumes of air

MR G. S JOHNSON has obtained ammonia (*Chem Soc. Journal*) by passing hydrogen and (presumably) pure nitrogen over cold or moderately heated spongy platinum. when however the mixed gases were passed over hot asbestos before traversing the spongy platinum, *no* ammonia was formed Mr. Johnson thinks that nitrogen probably exists in two forms, an active and an inactive form, the latter being produced by the action of heat on the former.

DR. DUPRÉ has introduced (*Analyst*) a slight modification into the ordinary method for observing a colour change in titrating with standard solutions, which is said to render the perception of the change very sharp and accurate. He views the liquid to be titrated through a glass cell containing a solution of the same colour as, and about equal in intensity to, the liquid itself.

M. LONGUININE has recently determined (in *Compt. rend.*) the heats of combustion of various alcohols of the allyl series, and compared the numbers with those expressing the heats of combustion of metameric aldehydes. He finds very marked differences between the two series of numbers, showing once more a distinct connection between the energy lost by a carbon compound in passing from one state to another standard state, and the structure of the molecule of that compound.

M. BERTHELOT, in continuation of his researches on compounds of metallic halogen salts with haloid acids, describes in *Compt. rend.* the action of gaseous hydrochloric and hydrobromic acids on alkali chlorides and bromides; he shows that the gaseous acids are absorbed by the dry salts with disengagement of heat, and that the products of the actions are possessed of properties which distinguish them from mere mixtures.

M. BERTHELOT also considers the reciprocal actions between alkali haloid salts and haloid acids; he shows that as a rule alkali chlorides are decomposed by hydrobromic acid, but that in some cases and under special conditions of temperature, bromides are decomposed by hydrochloric acid. The general results are shown to be in keeping with the laws of thermochemistry. That action in which most heat is evolved occurs, but the products of the action may be unstable under experimental conditions, and hence the primary change may be modified, or even reversed.

M. MÜNTZ states that his investigations have shown that traces of alcohol exist in all natural waters, whether rain, river, sea, or snow water. He describes his method of applying the iodoform test for alcohol, whereby one part can be detected in 1,000,000 parts of water.

PHYSICAL NOTES

M. LAURENT of Paris has constructed "magic mirrors" giving similar effects to those brought from Japan, but of glass silvered at the back instead of metal. By engraving patterns at the back and silvering the front surface, the mirror has a perfectly plane surface only when the air-pressures at the front and back are equal. If the air behind be compressed or rarefied the thinner parts will have relatively a greater convexity or concavity than the rest, and in the disk of light which the mirror reflects on to a wall from a luminous point the pattern engraved on the back will accordingly appear dark or light.

FROM experiments on the radiation and conduction of heat in rarefied gases (*Wied. Ann.*, No. 13) Herr Graetz finds the results in much better agreement with Stefan's law of radiation than with that of Dulong and Petit, and "it may be affirmed that in the temperature-interval from 0° to 250° C. the radiation is very nearly proportional to the fourth power of the temperature." The factor of proportionality σ (in Stefan's formula $Q = \sigma T^4$) is then that amount of heat which is radiated from one square centimetre of a substance of − 272° C. in a second towards a space of the absolute temperature 0° (− 273°). By the method of least squares Herr Graetz finds

$$\sigma \text{ for glass} = 1 \cdot 0846^{-10} \frac{\text{gramme centigrade}}{\text{centim. seconds}}$$

Certain divergences at low temperatures suggest that while the intensity of radiation grows with rising temperature, it perhaps grows differently for different heat colours.

IN a recent communication to the Munich Academy, Herren Nies and Winkelmann describe an inquiry into the volume-changes of various metals in solidifying. Of eight metals examined, six (viz. tin, zinc, bismuth, antimony, iron, and copper) were proved to undergo expansion in passing from the liquid to the solid state. For three of the metals approximate values for the amount of this expansion were obtained (tin showed an expansion of 0·7 per cent., zinc 0·2, and bismuth 3). Two metals (lead and cadmium) gave doubtful results, but the authors find some reason to believe that they also expand in solidifying. So far then the rule would appear to be general for metals.

M. TRÈVE describes in the *Comptes rendus* some curious observations from which it would appear that when light is admitted from a natural or artificial source through a slit, more light passes if the slit be horizontal than if it be vertical. M. Trève has produced photographs taken behind slits in various positions to prove that the effect is not an illusion of the eye. The phenomenon appears to us inexplicable, but certainly requires further proof to substantiate its reality.

M. MERCADIER still continues to study radiophonic phenomena. He finds it possible to increase the effects by uniting in one tube the vibrations of several receiving disks. He also finds it possible to construct tubes whose length corresponds to the wave-length of the vibrations radiophonically excited, and which respond to the note emitted. M. Mercadier hopes by these means to re-determine with increased accuracy the velocity of sound in air and other gases.

WITH regard to the beats and beat tones of harmonic intervals Dr. Koenig argues (*Wied. Ann.* No. 3) against Prof. Helmholtz's view, that these are due to harmonic tones of the lower primary sounding with the higher (Dr. Koenig, in his former experiments, having used strongly-excited tuning-forks). He shows how the phenomena may be studied with the aid of a "wave-syren," in which a blast of air is sent through a slit against the serrated border of a rotating disk, or of a ring-section of a thin cylinder. He has the border of the disk cut to represent accurately the curve produced by combination of the curves of two simple tones, giving an air motion, when blown against, quite like that from the two tones sounded together. The beats and beat-tones are then heard. With a mere wavy outline for the border and the slit at right angles one hears a quite simple tone, which however is at once changed to a "clang" with strong overtones, when the slit is slanted a little. Now, with two simple tones got thus the beat-tone heard when the slits are at right angles should (on Helmholtz's supposition) be less distinct than when, the slits being slanted, the overtones are brought out; whereas the reverse is the case.

DR. KOENIG, in the same number, describes a simple lecture-apparatus for producing beat-tones. It consists of two glass rods of different length, clamped in vertical position by the middle to a jointed frame, which, through an elastic contrivance, keeps their lower ends pressed against the cloth-covered periphery of a wheel which dips in water in a trough. The friction calls forth the longitudinal tones and the beat-tone.

AN improved form of the Töpler air-pump has been devised by Herr Bessel Hagen (*Wied. Ann.*, No. 3), with which considerably higher vacua can be reached than those Mr. Crookes obtains with the more complicated and fragile Sprengel-Gimingham apparatus. The average limit of rarefaction was found to be $\frac{1}{38}$ millionths of an atmosphere ($\frac{1}{58}$ in one case), while the other pump only gives $\frac{1}{17}$ millionth. (It is noted that Prof. Ogden Rood has obtained $\frac{1}{54}$, and in one case even $\frac{1}{170}$ with a modified Sprengel.) With his highest vacua the author found electricity to pass (using plate electrodes and a strong Holtz machine, with Leyden jars). He considers mercury-vapour an insulator for electricity, but shows that radiometric movements depend greatly on its pressure *in vacuo*. No diffusion of hydrogen through the glass could be detected.

AN artificially formed body showing polar effects in the way of attraction and direction is produced by Herr Holtz (*Wied. Ann.*, No. 3) thus. To one end of a short glass rod is cemented a plane piece of glass, and to this a short narrow glass tube (in a line with the rod). In the tube is placed a sewing-needle longer than it, and carrying at its head a thin pasteboard disk (22 mm. across), which has attached on one half of its periphery, reaching over both above and below, a pasteboard strip (10 mm. broad); opposite this, on one of the surfaces, is fastened a small projecting point of tin-foil. Brought between hollow disks fixed to the rods of a Holtz machine, the tin-foil point always turned to the positive pole. Next, the glass rod with its disk was attached to the end of a light horizontal glass tube, hung bifilarly, and so brought between the hollow disks. The disk first turned into position, and was then attracted towards the negative pole. The phenomena are thought to illustrate unipolar conductivity.

THE simple tourmaline-pincette, by reason of its small field, can be used with only a small number of crystals. To enlarge the field M. Bertin has applied to it a part of the lenses of the polarising microscope. This, it is known, consists, first, of a polariser and focus; second, of a microscope and analyser. The polariser and analyser, at the extremities, are pretty large pieces, and if replaced by two tourmalines placed between the focus and the microscope (of simplified form) the apparatus is rendered much smaller and handier. This is the principle of M. Bertin's new tourmaline-pincette (of which details will be found in the

Journal de Physique for March). It shows very well the fringes of a crystal only 2 mm. in diameter and ½ mm in thickness, and all uniaxial crystals give fringes in it. With the old pincette only two biaxial crystals can be observed (nitre and lead crystal), the limit for the exterior angle of the axis being about 17°, but in the new instrument, a small calamine plate, with axes 78° 20′ apart, showed the fringes well.

ACCORDING to M. Angot (*Jour. de Phys*, March) the psychrometer, of whatever form, may give pretty good indications in the hands of careful observers, in these regions (France), so long as the atmospheric pressure is not far from 760 mm, the wet bulb thermometer is above 1° or 2°, and the difference of the two thermometers remains below 12°, but otherwise the ordinary formulæ become illusory.

THE influence of atmospheric electricity on the vegetation of the vine has been studied near Palermo by M. Macagno (*Jour. de Agr Prat.*) thus: Sixteen stocks were rendered more subject to the effects of the electric tension by means of a copper wire inserted vertically with platinum point in the upper end of the fruit branch, while another wire connected the bottom of the branch with the ground. This continued from April to September. An acceleration of vegetation was proved by the wood of these stocks containing less mineral matters and potash than that of the other stocks, while the contrary occurred in the leaves, and in these the potash was mostly in the bitartrate form. A much greater quantity of must was got from the grapes of those vines, and it had considerably more glucose and less acid.

A DETERMINATION of the electric phenomena which occur on contact of metals and gases has been attempted by Herr Schulze-Berge in Berlin (*Wied Ann* No. 2). He worked with a condenser having two circular plates of a given metal, the upper plate being connected with an electrometer and submitted to contact with various gases or to vacuum, the lower connected to earth. The quantity of electricity from a known source requiring to be communicated to the upper plate to make its potential equal to the lower, was measured. *Inter alia*, ozone was found to make gold, platinum, and brass negative to a plate of the same metal in air. Hydrogen always made platinum strongly positive, while its influence on gold was hardly perceptible, and on brass qualitatively various. Chlorine made platinum negative; ammoniacal gas (from aqueous solution) made brass positive. The amount of difference of potential with as similar treatment as possible of a given pair of plates was very different in the several observations of a series. Nor could a certain relation be discovered between it and the time of action of the gas. It was greatest with two platinum plates, one in hydrogen (viz. 0·214 D). It gradually decreased to a point generally somewhat short of that at the beginning. As to the cause of this decrease, the author thinks it probable that a gradual neutralisation of the electrical double layer takes place.

THE DEVELOPMENT OF HUMAN INTELLIGENCE

THE Department of Education of the American Social Science Association has issued the following Circular and Register, which we commend to the notice of our readers, some of whom may be able to give Mrs Talbot answers to the questions given below:—

WE have been made familiar with the habits of plants and animals from the careful investigations which have from time to time been published—the intelligence of animals, even, coming in for a due share of attention. One author alone contributes a book of one thousand pages upon "Mind in the Lower Animals." Recently some educators in this country have been quietly thinking that to study the natural development of a single child is worth more than a Noah's ark full of animals. Little has been done in this study, at least little has been recorded. It is certain that a great many mothers might contribute observations of their own child's life and development that might be at some future time invaluable to the psychologist. In this belief the Education Department of the American Social Science Association has issued the accompanying Register, and asks the parents of very young children to interest themselves in the subject—

1. By recognising the importance of the study of the youngest infants.
2. By observing the simplest manifestations of their life and movements.
3. By answering fully and carefully the questions asked in the Register.
4. By a careful record of the signs of development during the coming year, each observation to be verified, if possible, by other members of the family.
5. By interesting their friends in the subject and forwarding the results to the secretary.
6. Above all, by *perseverance* and exactness in recording these observations.

From the records of many thousand observers in the next few years it is believed that important facts will be gathered of great value to the educator and to the psychologist.

First Series—REGISTER OF PHYSICAL AND MENTAL

Development of (Give the Baby's full name) . .. .
Name and occupation of the father? . . ..
Place and time of father's birth? . .
" " mother's " ? . .
" " baby's " ?
Baby's weight at birth at 3 months?
" " 6 months? at 1 year? . .
Is baby strong and healthy, or otherwise?
At what age did the baby exhibit consciousness, and in what manner? .

AT WHAT AGE DID THE BABY

smile? ..
recognise its mother? .. . . . .
notice its hand?
follow a light with its eyes?
hold up its head?
sit alone on the floor?
creep?
stand by a chair?
stand alone?
walk alone? .
hold a plaything when put in its hand? .
reach out and take a plaything?
appear to be right or left handed? ..
notice pain, as the prick of a pin? .
show a like or dislike in taste? .
appear sensible to sound? .
notice the light of a window or turn towards it?
fear the heat from stove or grate?
speak, and what did it say? ..

HOW MANY WORDS COULD IT SAY

at 1 year? at 18 months? . at 2 years? ....

Will the mother have the kindness to carefully answer as many as possible of these questions and return this circular, before July 15, 1881, to Mrs. Emily Talbot, Secretary of the Education Department of the American Social Science Association, 66, Marlborough Street, Boston, Mass.

Boston, March 1, 1881

In connection with the inquiry indicated above, the following letter from Dr Preyer of Prussia, addressed to Mrs Talbot, will be found of interest:—

Jena, November 22, 1880

DEAR MADAM,—It has given me much pleasure to read your letter and the extract of a paper of mine on "psychogenesis," or "the growth of volition, intellect, &c., in infants," and I readily comply with your wish to have this paper sent off without delay. You will find it reprinted in the book accompanying this letter, p. 199–237. I am about to publish an extensive work on the same subject, which is to contain all my observations and a careful analysis of the phenomena which the development of the faculty of speech presents. This book is to be printed next year. I am sorry to say that a reliable investigator of the whole subject is not known to me. Your newspaper seems to be right in calling the field "as yet almost unbroken." Prof. Kussmaul's "Seelenleben des neugeborenen Menschen" (Leipzig and Heidleberg, 1859), and Mr. C Darwin's biographical sketch of an infant, contain some good observations, but both are very short. Many excellent remarks on infants and very young children I find in Mr. C. Darwin's book, "On the Expression of the Emotions." The German books on the subject, although numerous, are nearly worthless, many are sentimental, giving no facts, or, what is worse, false statements. B. Sigismund's "Kind und Welt" (1851) is an exception.

The case you mention of a child of eleven months expressing

its wishes and inducing the nurse to comply with them cannot be definitely looked at as a case of self consciousness, but only of consciousness This is one of the most intricate questions to decide—*when* the child distinguishes its own body, head, hands, &c., from other objects, as belonging to himself. The first time a child says "I" and "me," in the correct sense, it may be considered to have passed the limit. The formation of ideas by associating impressions, as well as the formation of general ideas (*Begriffe*) by uniting similar qualities of different objects, is intellectual work done by the child long before it knows anything of its own individuality. It seems to me that self-consciousness does not arise suddenly, but by degrees, after many experiments have shown the difference between touching his own body and external objects with his little hand

I have been occupied with psychogenetical problems since nearly four years, continually collecting facts Should you be able to awaken some interest for these most important investigations (I mean the physiology and psychology of infants), I think the trouble taken would soon be repaid by the results

I am, sincerely,

DR. WM. PREYER, Professor

P.S —Perhaps the observations and experiments on the senses (sight, hearing, smell, taste) of new-born animals and infants which I published in *Kosmos* (Zeitschrift herausgegeben von E Krause), vol. III pp. 22-37, 128-132 (1878, Leipzig), may have some little interest. In England Romanes has written very able papers on the development of instinct and intelligence His address is 18, Cornwall Terrace, Regent's Park, London

Yours, &c., W. P.

ABNORMAL BAROMETRIC GRADIENT BETWEEN LONDON AND ST PETERSBURG IN THE SUN-SPOT CYCLE

BEFORE alluding to the subject which forms the heading of the present communication, I must apologise for having allowed some rather serious errors to creep into the figures given for the barometric abnormals of London in my letter to NATURE, vol. XXIII. p 243. The errors were caused by a friendly computer taking the differences from the mean for each year incorrectly in one or two cases

I am glad to say however with respect to the relation between the barometric abnormals as there given and the sun spot numbers, that far from its being vitiated by the corrections which have now been made, they on the contrary considerably strengthen it, as is evident when the following corrected values for the mean cycles are compared with those given in my former letter:—

LONDON

Annual Barometric Abnormals, Mean Cycles

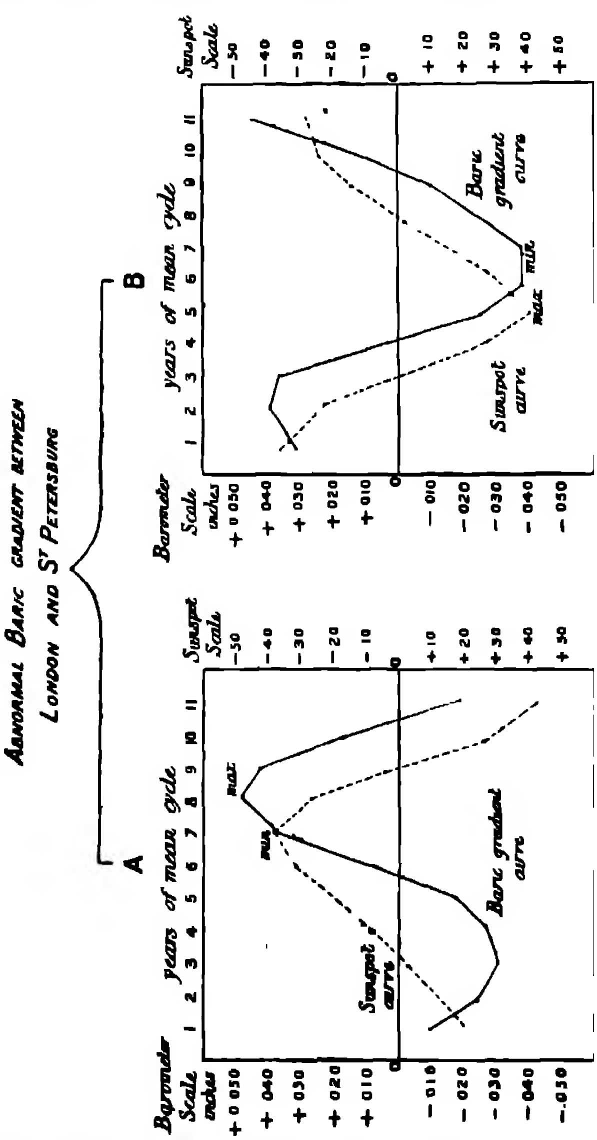
	Maximum years in fifth line		Minimum years in seventh line	
	Pressure (1811–77)	Sun spots (1811–77)	Pressure (1816–79)	Sun-spots (1816–72)
1.	+0·011	−33·9	−0·006	+23·3
2.	+0·024	−23·4	−0·003	+14·5
3	+0·017	0·0	−0·002	+ 4·8
4.	−0·003	+28·2	−0·004	− 5·6
5.	−0·011	+43·1	−0·006	−19·0
6.	−0·012	+34·2	−0·002	−32·5
7.	−0·008	+16·8	+0·003	−37·1
8.	±0·000	+ 0·2	+0·020	−25·4
9	+0·002	−14·2	+0·025	+ 1·8
10.	+0·010	−24·2	+0·010	+30·9
11.	+0·008	−26·3	−0·009	+44·8

If now we take these corrected figures, and subtract from them those given in NATURE, vol. XX. p. 28, for St. Petersburg (reduced to inches), which comprise very nearly the same period, we get for the abnormal annual baric gradient from London to St. Petersburg in each year of the mean cycle, the following figures:—

Abnormal Annual Barometric Gradient between London and St. Petersburg

	(B) Maximum years in fifth line		(A) Minimum years in seventh line	
	Pressure London–St Petersburg (1811-77). (1822 71) inches	Sun-spots (1811-77)	Pressure London–St Petersburg (1816-79) (1822-71) inches	Sun-spots (1816-72).
1.	+0·032	−33·9	−0·012	+23·3
2	+ ·038	−23·4	− ·027	+14·5
3.	+ ·036	0·0	− ·033	+ 4·8
4	+ ·007	+28·2	− ·029	− 5·6
5.	− ·029	+43·1	− ·018	−19·0
6	− ·040	+34·2	+ ·010	−32·5
7.	− ·040	+16·8	+ ·036	−37·1
8.	− ·025	+ 0·2	+ ·048	−25·4
9	− ·012	−14·2	+ ·041	+ 1·8
10.	+ ·013	−24·2	+ ·016	+30·9
11.	+ ·043	−26·3	− ·018	+44·8

An inspection of these figures at once reveals the existence of a



baric gradient oscillation of single period, closely following the inverse sun-spot oscillation.

In order to exhibit the constancy of the lag in the occurrence of the gradient variations behind those of the sun spots, as well as the remarkable similarity in form of the two oscillations, I have reproduced the above figures graphically in the accompanying diagram, in which the baric gradient abnormals are plotted out simultaneously with the *inverted* sun-spot abnormals:—

It will be observed that there is an almost uniform lag in the baric gradient curve behind the inverted sun-spot curve of a little more than a year, while a variation of 01 inches on the barometer scale corresponds very nearly throughout (allowance being made for the lag) to 10 on the sun-spot scale.

As the strength of the prevailing west and south-west winds of these regions must necessarily depend on the amount of the baric gradient between places on the edge of the European continent like London, and those inland, and to the north as St. Petersburg, there is fair ground for concluding that the west and south west winds must on the whole be stronger in years of minimum sun-spot than in those of maximum sun-spot

Some direct evidence in favour of this notion has already been communicated to NATURE by Mr S A. Hill and Mr Ellis of the Greenwich Observatory

Moreover the amount of variation in the strength of the wind between London and St Petersburg, following upon the change in the barometric gradient between the two during the cycle, should be enough to cause a *sensible* variation in the character of the weather, for according to Mr. Blanford the mean barometric gradient over the Bay of Bengal during the south west monsoon is about 0·025 inches in 100 miles.

Now as the distance from London to St Petersburg is about 1300 miles, in order to maintain a current of air between them throughout the year equal to that of the summer monsoon in the Bay of Bengal, there would have to be a total annual barometric gradient of 0 0325 inches As the range of the abnormal gradient in the present case amounts to 0·08 inches it should cause a variation in the wind equal to one-fourth that of the monsoon

For the period 1822-71 the normal mean annual gradient from London to St Petersburg is + 0 098 inches The variation of the abnormal is therefore nearly equal to the normal gradient.

Taking the results just obtained with those given by Mr H. F Blanford in his article in NATURE, vol xxi p 477, it may be concluded that there is a barometric "see-saw" between Russia and Western Siberia and the Atlantic coasts of Europe, similar to that between the former districts and Indo-Malaysia.

Just as in the latter case the relation will probably be found to be more marked in the winter months, and may also be found to explain some of the numerous facts already ascertained regarding variations in the rainfall, cloud, and temperature of Western Europe, at different epochs of the sun-spot cycle

E DOUGLAS ARCHIBALD

CONGRESS OF THE FRENCH LEARNED SOCIETIES

THE session of the Congress of the French Learned Societies has lasted only three days, but has exhibited an unusual amount of interest. Many papers were read in the section of Science presided over by M. Milne-Edwards, the veteran member of the Institute.

M. Alluard summarised the results of rotation of the wind as registered by anemometers at an altitude where it is not to be feared that surface-friction should interfere. The number of rotations from north to south was 113. Of these 83 were in the positive direction, or by east, and only 30 by west; 49 of the 83 positive were continued to the west, and 34 stopped at the south or vicinity; consequently when a wind has come from north to south by east, the greater probability is that it will continue rotating to the west When it has rotated to the west the probability is even greater that it will continue to the north. Again, of the 49 three-quarter rotations observed not less than 32 were completed, and only 17 stopped at the west and vicinity. The same thing cannot be said of the negative rotations: only 13 were from north to east, and of these only 6 were from north to north by west. These results are a confirmation of Dove's well known law.

General Nansouty, the director of the Pic du-Midi Observatory, announced that the new buildings on the top of the mountain will soon be ready, and that next winter he will use them for taking readings. It is curious that the last winter has been one of unusual mildness in this exalted altitude.

M. Hébert read a long paper on the formation of cyclones, which he explains by the influence of mountain ranges on the great atmospheric currents loaded with humidity

M. Vidal presented a photometer based on the action of light on a selenium element of the ordinary construction M. Vinot, editor of *Le Ciel*, presented a refractor mounted equatorially, of which the price is less than 10*l*., with a magnifying power of 150 M. Joubert gave details on the working of the Trocadéro Popular Observatory, which is now in constant operation, and where lectures on astronomical subjects are delivered regularly.

M. Guillemare read a paper on the use of soleine for lighting purposes. This product has been obtained by the distillation of a number of resinous matters, which have a point of ebullition from 150 to 160 Centigrade and a mean density of 0·860 When they have been freed from every other matter they can be used in a specially-prepared burner. This soleine can be prepared in immense quantities in all countries where pines are abundant

A number of interesting communications were made on palæontology and zoology, generally advocating Darwinian views.

The final sitting was presided over, as usual, by the Minister of Public Instruction, and took place in the large hall of the Sorbonne. A number of crosses of honour and medals were distributed.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The lectures of the summer term commence this week At the University Museum Prof Clifton will conduct a class in practical physics and will lecture informally on the use of optical instruments. Mr Stocker will give an experimental lecture in mechanics, and Mr V. Jones will lecture on mechanical problems, in continuation of their courses last term Prof Odling will continue his course of lectures on organic chemistry, and Mr Fisher will finish his inorganic course

At Christ Church Mr Harcourt lectures on the metals, and Mr Baynes on the theory of gases At Balliol Mr. Dixon gives an experimental lecture in elementary physics

In a Congregation holden on Tuesday, April 27, it was resolved that candidates, not being members of the University, may present themselves at any of the ordinary examinations for Responsions. Last term a statute was passed instituting an examination to take place in the Long Vacation This examination, which can be passed by candidates before matriculation into the University, is to be passed in lieu of Responsions The effect of the statute will be that all young men may pass Responsions before they matriculate, and less of their University time will be consumed in getting up school work.

The proposal to designate the unattached students as students of the University Hall was lost by a large majority, 90 voting against the proposal and only 9 for it.

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, April 21.—Dr. Debus in the chair.—It was announced that a ballot for the election of Fellows would take place at the next meeting, May 5.—The following papers were read:—On the distillation of mixtures of carbon disulphide and carbon tetrachloride, by F. D Brown. The objects of the research were to find the boiling-point of every possible mixture of the two liquids, and the composition of the vapour evolved by any mixture when boiling Tables and curves giving these results accompany the paper. The author also finds that the composition of the vapour evolved is independent of the pressure under which ebullition takes place —On the estimation of hydric peroxide by means of potassic permanganate, by W. E Adeney.—On the oxidation of sulphurous acid, by H. P. Dixon. The author finds that when sulphur dioxide, steam, and oxygen are exposed to a temperature of 100° C no diminution of volume takes place, and therefore no sulphhuric acid is formed. If the temperature be allowed to fall so that water condenses, a slight contraction in volume is observed —On the reduction of cinnamic alcohol, by F. Hatton and W R Hodgkinson. When this substance is heated to 100° C. for three or four days

with sodium amalgam (containing 15 per cent. sodium), and a small quantity of water cinnamene and methylic alcohol are produced.

Entomological Society, April 6.—W. L. Distant, vice-president, in the chair.—One Ordinary and one Honorary Member were elected.—Mr. J. Jenner Weir exhibited an undetermined *Noctua*, apparently allied to the genera *Dicycla*, or *Gortyna*, which was found in a nursery garden at Blackheath in August last.—Mr. R. McLachlan exhibited three rare species of the Neuropterous genus *Dilar*, Ramb.—Rev. A. E. Eaton exhibited a specimen of *Haplophthalmus elegans*, Schobl, a wood-louse new to the British fauna.—Miss E. A. Ormerod exhibited two termites' nests from British Guiana.—Mr. T. R. Billups exhibited specimens of two rare British insects—*Ichneumon erythræus*, Gr., and *Laricsomus enervis*, Herr. Schaff.—The Secretary announced the death of Herr J. H. C. Kawall, a well-known entomologist of Courland, at the age of eighty two.—Mr. R. McLachlan read a description of a new species of *Cordulina* (*Gomphomacromia fallax*) from Ecuador.—Mr. J. B. Bridgman communicated a paper entitled "Some Additions to Mr. Marshall's Catalogue of British *Ichneumonidæ*." Upwards of sixty species (most of which were exhibited to the meeting) were noticed as new to the British fauna, including thirteen new to science.

Meteorological Society, April 20.—Mr. C. Greaves, F.G.S., vice-president, in the chair.—W. H. Goss, F.G.S., and Admiral I. L. Massie were elected Fellows of this Society.—The following papers were read:—On the frequency and duration of rain, by Dr. Wladimir Koppen of Hamburg.—Results of experiments made at the Kew Observatory with Hogen's and George's barometers, by G. M. Whipple, B.Sc., F.R.A.S.—On a discussion of Mr. Eaton's table of the barometric height at London with regard to periodicity, by G. M. Whipple, B.Sc., F.R.A.S.

Anthropological Institute, April 12.—F. W. Rudler, F.G.S., vice president, in the chair.—The election of Lieut.-Col. R. G. Woodthorpe, R.E., and of Thomas Vincent Holmes, F.G.S., was announced.—Mr. Joseph Lucas read a paper on the ethnological relations of the Gypsies. In tracing back the past history of the races described under the common name of Gypsies we pass through two periods—the first *historical*, dating from A.D. 1414; the second partly historical, partly inferential. This older section formed the subject of Mr. Lucas's paper. The author premised that linguistic evidence shows that the various tribes of Gypsies now scattered over Europe can be referred to several Eastern tribes from India to Persia. The investigation dates back to archæological times, especially in relation to the working of metals and the presence of a large number of pure Sanscrit words in the language of European Gypsies, many of which do not occur in Hindustani. The "archæological" section embraces all that was not included under the several sections—"The Gypsies in Egypt," "Gypsies among the Romans," or "The Dark Ages"; but a good deal of the evidence upon which the archæological conclusions rest runs through those several sections, as well as through sections specially devoted to the names *Zingâro* and *Rom*. It will thus appear that the term "Gypsy" is used by the author in the widest sense as meaning "an Asiatic tribe which has wandered into Europe," though strictly it should mean only those who came by way of Egypt.

PARIS

Academy of Sciences, April 18.—M. Wurtz in the chair.—The following papers were read:—Microscopic inscription of movements observed in physiology, by M. Marey. The accuracy of the curves from M. Marey's instruments has been doubted, on the ground that vibrations proper to the light lever may be added to the physiological movement. He now removes this objection by greatly diminishing the range and velocity of the lever so as to give microscopic curves on smoked glass (which is also moved more slowly). The inertia of the lever becomes negligible. The curves, when examined in the microscope or by projection, are found identical with the others. The method greatly extends the field of phenomena that may be registered, *e.g.* the vibrations of blood in the vessels, which give a sound, produce a distinct microscopic trace. The portable character of the apparatus is an advantage.—On the Eulerian integral of the second species, by M. Gyldén.—On the surface of Kummer with sixteen singular points, by M. Brioschi.—On the action of heat on ammoniated bases, by M. Hofmann.—Report on a memoir of M. Perissé, entitled "Causes which tend to warp the Girders of Iron Bridges, and Means of Calculating these Girders for Resistance of Warping Forces."—On the secondary battery of M. Faure, by M. Reynier. This is an improvement on M. Planté's. M. Faure quickly gives his couples a power of almost unlimited accumulation by covering the lead electrodes with a layer of spongy lead formed and retained thus: The two sheets of lead are each covered with minium or other insoluble oxide of lead, then with a felt envelope held by lead rivets. They are then placed near each other (in spiral, it may be) in acidulated water. The electric current changes the minium to peroxide on the positive electrode, and to reduced lead on the negative. On discharging, the reduced lead is oxidised and the peroxidised lead reduced. A quantity of energy capable of giving 1-horse power for one hour may be had with a Faure battery of 75 kg. The battery, under certain conditions, returns 80 per cent. of the work expended in charging it.—A letter from Ampère to Lacroix was read. It was written when he was Professor in the Lyceum of Lyons, and expresses his enthusiasm for mathematical studies.—On the earthquake of Chio, by M. de Pellissier, Consul-General at Smyrna. The amplitude of the first oscillation, on the afternoon of April 3, was estimated to be between 0·15 m. and 0·20 m. From then till the 5th 250 shocks were felt, thirty or forty of which were capable of throwing down a solid wall. All the oscillations were in the direction east to west. The Governor's palace, of very light construction, but chained throughout at the level of each storey, resisted all the shocks, while the wall inclosing the grounds, 0·70 m. thick, was everywhere thrown down. Smyrna has become a refuge for the wounded.—On Fuchsian functions, by M. Poincaré.—On Abelian functions, by the same.—On a class of functions, the logarithms of which are sums of Abelian intervals of the first and third species, by M. Appell.—On the formulæ of representation of functions (continued), by M. Du Bois-Reymond.—On stellar photography, by Prof. H. Draper. By exposing 140 minutes in the telescope, he has succeeded in photographing stars of magnitude 14·1, 14·2, and 14·7 (Pogson's scale) in the nebula of Orion; the weakest is of the sixteenth magnitude on Herschel's scale. The minimum of visibility for the 9-inch telescope used has been thus nearly reached, and Prof. Draper hopes soon to be able to go still further. The nebula extends over a surface about 15′ in diameter.—Action of electrolysis on toluene, by M. Renard.—Structure and comparative texture of the ink-bag in cephalopoda of the French coasts (continued), by M. Girod. The species observed were *Sepia officinalis*, *Loligo vulgaris*, *Sepiola Rondeleti*, and *Octopus vulgaris*.—On the large dunes of sand of the Sahara, by M. Rolland. These dunes move toward the south-east, and the sum of sand is increased by disaggregation of rocks; but the movement and increase are almost insensible in a generation.

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